NOVEMBER, 1951

METAL FINISHING

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS
FOUNDED 1903

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DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

METAL FINISHING

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COMING SOON

Abstracts of plating and finishing papers given at the recent meeting of the Electrochemical Society.

Using radio-active barium as a reagent for rapid determination of sulfate in chrome plating baths.

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A fundamental discussion of the various abrasives, binders, and lubricants used in modern buffing and polishing compositions.

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The WASHINGTON OBSERVER

George W. Grupp

News and Views from The Nation's Capitol

. Our present military strategy is not to stockpile weapons, which would soon become obsolete, but to stockpile production plants for all-out production in event of total war.

. The bulk of the contracts awarded for our present defense needs are now beginning to be translated into production. By next year production on these contracts will be in full swing, and an additional 3,000,000 workers will be needed.

. Only those having ratings issued by the Department of Defense and the Atomic Energy Commission are permitted to use such ratings to acquire chemicals. All other users of chemicals must now buy through the normal market procedure with the assistance of any ratings, according to NPA Regulation 2, Direction 3.

. The Munitions Board has issued a pamphlet called "How To Be Cleared For Handling Classified Military Information Within Industry". This is a step-by-step guide to prospective defense bidders. It may be obtained for 10 cents from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

. The Defense Materials Procurement Administration has agreed to buy the entire zinc output of the Vulcan Mines Co. of Lima, Peru for the next three years. The company's rich deposits of zinc are located in the mountains of Ticlico, Peru.

. Tin production in Malaya during the first six months of 1951 totaled 28,015 long tons, as compared with 28,945 long tons for the same period in 1950. Further restrictions on the usage of pig tin have been invoked by amending Tin Order M-8.

. Since the Canadian producers of nickel have increased their capacity, the prospects of this metal are a little brighter for next year. For June, however, consumption was up 8% over May, while imports declined 9% for the same period.

. American capital is reported to be preparing to develop new and important deposits of copper ore found in the Peruvian department of Tacna. The NPA also thinks it can salvage about 100,000 pounds of copper drippings from the projector arc lamps of 20,000 motion picture theatres.

. The NPA, in amending order M-80, has authorized the use of nickel silver in the manufacture of functional parts of certain musical instruments.

. The rate of world production of lead in 1951 is about 1,860,000 short tons, the same as in 1950. In 1950 the United States used about 1,214,000 short tons of this metal. The nation's 1951 lead supply is estimated at 410,000 tons from domestic production; 440,000 tons from scrap; and 180,000 tons from foreign imports.

. The Central Military Procurement Office, which was located in the Old Post Office Building in Washington, D.C., has been moved to the Pentagon Building in Arlington, Virginia.

METAL FINISHING

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TO EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

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WANTED—SCRAP

At Washington meetings of N.P.A. authorities and metal industry specialists these days the Number 1 problem under discussion is SCRAP. This is, admittedly, a novel use for the word "scrap" in the nation's capitol, but those concerned with the problem are unanimous in their opinion that metal scrap is the key to the whole program of metal availability for the next year or more.

While steel and iron scrap is the most vital, it cannot be overemphasized that scrap metal of all types is most urgently needed to keep our industries going. Thirty-six million tons of scrap iron and steel will be needed next year, an amount approximately equal to the entire output of our enemies! Available supplies of copper, aluminum, nickel, etc., are all far short of anticipated requirements. The only way this staggering amount of scrap can be accumulated is through the most searching and thorough of scrap recovery programs in each and every metal-working plant in the country.

Plating shops are notorious accumulators of various and sundry types of metal scrap — old, corroded, or unused steel tanks, worn-out copper racks, lead sheet and linings, unsalvageable products, obsolete wire baskets and many more. A significant contribution to the national welfare, as well as a much-needed housecleaning could be combined in an effort to get all of this vital metal back into circulation.

Scrap collection is being alerted all along the line, to see that *any* small amount of *any* kind of metal is returned speedily to the mills, and a more worthwhile project in any slightly idle plating room would be hard to find. When (and if) the full impact of an all-out war strikes the countries' plating plants, there may not be time nor manpower to spare for this job. The time to get going on it is now, when it is most urgently needed.

Make no mistake about it, the amount of scrap returned to the mills will be a determining factor in how much metal you can count on for future operations.

W. A. Raymond

Editor

The Control of Bright Zinc Plating

By F. J. Kolar, Jr., *Western Electric Co., Chicago, Ill.*

In this article the author questions the value of controlling bright zinc baths by controlling the cyanide-zinc ratio. He also questions the value of brighteners in zinc baths.—*Ed.*

The Author

Mr. Kolar is a graduate of the University of Illinois with a Bachelor of Science Degree in Chemical Engineering. Prior to World War II he was engaged in metallurgical work in the steel industry. During the war Mr. Kolar was a commissioned officer in the Chemical Warfare Service and was stationed at Pine Bluff Arsenal on munitions manufacture. Since the war he has been a member of the engineering staff of the Western Electric Company, Inc. at Chicago and has conducted engineering investigations on finishing apparatus and equipment.

THE first portion of this article consists of a recommendation to electroplaters to discard two practices currently advocated and fairly commonly employed in the belief that their use is advantageous in the production of bright zinc electrodeposits. These practices are (1) the control of the cyanide-zinc ratio, and (2) the use of addition agents. The second portion of this article consists of a report on two ideas for process control which appear to have considerable merit; namely, (1) analytical control of the sulfide purifier, and (2) statistical quality control for automatic plating operations.

Cyanide-Zinc Ratio

Consider first the recommendation to discontinue the use of cyanide-zinc ratio in zinc plating control. To fully appreciate the inadequacy of controlling this ratio, it will be helpful to look into the inner workings of the cyanide zinc bath. First of all, it is known that the solution consists basically of zinc, sodium, cyanide, and hydroxyl ions, the zinc present as two complex ions, the zincate and the sodium zinc cyanide. It is known that these components are always in a state of equilibrium with each other. This state of equilibrium is illustrated in the form of a pan balance (Fig. 1) with the components that react with each other on each side of the balance. The chemical equilibrium that is present is indicated by the equation below the balance. To a chemist this equation means that a solution containing these components is in equilibrium, and if any of the components are added to the solution the reaction will be driven in a direction that will result in the formation of more of the components on the other side of the equation, eventually re-establishing the equilibrium. In the analogy of the pan balance, if an addition of one of the components was made, the balance would tip at first, but as a result of chemical processes a change would take place which would result in the formation of the components on the other side of the pan balance, which would then gradually come back into a balanced condition. In practice, only two of the components are actually added as such, namely the sodium hydroxide and sodium cyanide. The complex ions are formed as a result of the chemical reaction only. Now, if zinc metal is added to the solution it reacts with the excess, or as it is also referred to, the "free" cyanide and hydroxide on both sides of the equation, with the result that the equilibrium remains essentially unchanged. For example,

$$Zn + NaOH + H_2O \rightarrow NaHZnO_2 + H_2 \uparrow$$
$$NaHZnO_2 + 4NaCN \rightleftharpoons Na_2ZnCN_4 + 3NaOH + H_2O$$

It should be pointed out now that, in a fundamental sense, the concentration of zinc has no bearing on the inherent electrochemical behavior of the zinc plating bath; that is to say, changes in the concentration of zinc do not effect the *nature (quality)* of the deposit. Any changes in efficiency are due to the *mechanical* effect of having more zinc available at the plating surface and solution interface. The latter point is illustrated by the fact that at low current densities the efficiency of the bath is the same regardless of the concentration of zinc, and at high current densities efficiency will remain the same provided that some *mechanical* means is used to assure that the zinc ions are delivered through the stagnant film on the cathode surface as fast as the zinc is plated out.

It follows then, that if the concentration of zinc

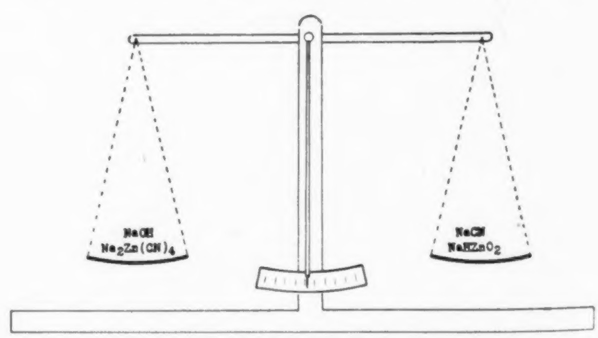


Figure 1. Illustrating the equilibrium conditions which exist in a cyanide zinc bath containing caustic soda. The equation is
$$3NaOH + Na_2Zn(CN)_4 \rightleftharpoons NaHZnO_2 + 4NaCN + H_2O$$

has no effect on either the chemical equilibrium or intrinsic electrochemical behavior of the bath, the cyanide-zinc ratio, which uses the *concentration of zinc as one of its principal factors,* is not on a fundamentally sound basis. It can be concluded also that the zinc-cyanide ratio may be misleading, because with any given ratio there can be a wide variation in the proportions of zinc present in the two complexes due only to the relative difference between the "free" cyanide and "free" caustic. That is to say, if the bath is adjusted so as to balance cyanide and metal with each other without regard to the relative hydroxide content, the bath will not necessarily be adjusted to conditions of maximum efficiency, or widest bright plating range, or both. To state this from another point of view, if a bath which is not producing the desired results is adjusted with respect to cyanide-zinc ratio alone, it may actually be adjusted in the wrong direction as to give even worse results than before.

That the relative concentrations of the two complex zinc ions is the controlling factor can be appreciated from the fact that a bath containing *one* of these complex ions, but *not the other, will not produce satisfactory results.* Straight cyanide-complex baths will produce acceptable deposits, but efficiency is very poor. Straight zincate baths have high efficiency, but deposits are spongy. When both complexes are present in a plating bath in proper proportions the best features of each are fortunately obtained, namely sound deposits at high operating efficiencies.

The point it is hoped has been established is that the important thing to control from the standpoint of the electrochemical behavior of the bath is the *ratio of the two complex ions.* Although the amounts of each cannot be determined by a direct chemical analysis, their concentrations depend upon the concentrations of the "free" or excess sodium hydroxide and sodium cyanide because of the equilibrium which exists. These in turn depend on total caustic, total cyanide, and total zinc, which can all be determined by regular analytical procedures.

To minimize confusing shop personnel, it is usually most satisfactory to establish definite desired concentrations of each constituents and replenish the bath as frequently as practicable. In the long run, the less the man in the shop is encumbered with talk of such things as complex ions, free cyanide, total cyanide, free caustic, total caustic, equilibriums, ratios, etc., the less confused he is apt to be whenever he runs into trouble, but even more important, the less experimenting he is apt to do on his own.

There are two questions concerning the cyanide-zinc ratio which have so far been left unanswered. One is: Why is it that experimental data show a strong correlation between the cyanide-zinc ratio and cathode efficiency? The answer probably is that in experimental studies it is usually the practice to hold the sodium hydroxide concentration constant while varying the cyanide-zinc, ratio, thereby indirectly varying the caustic-cyanide ratio which controls the relative proportions of the two complex zinc ions, which, as stated before, is really the controlling factor. Another possibility is that the effect of purely mechanical changes such as agitation may be overlooked. Also, since cyanide is the most difficult to maintain at a fixed con-

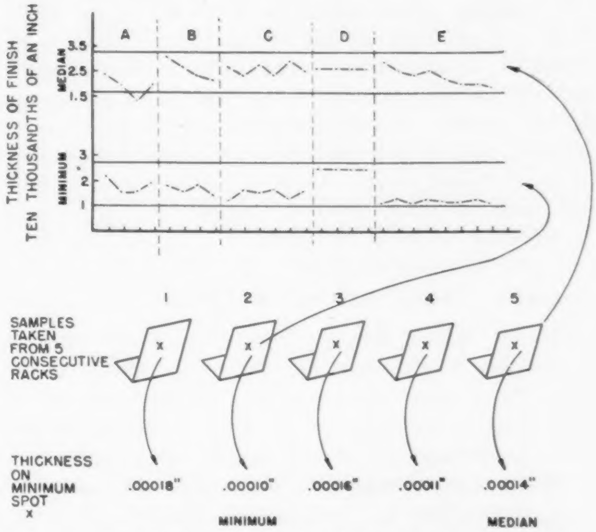


Figure 2. Statistical control of the plating process through a systematic sampling scheme. Refer to text for explanation.

centration, it is natural that these components have been tied together when thinking of control.

The other question is: Isn't the zinc concentration important? From a commercial standpoint the concentration of zinc is highly important, but the reason for its importance is different from that implied in the use of a cyanide-zinc ratio. Obviously, if the zinc concentration is low the current density that can be employed efficiently is limited by the possibility of the zinc being plated out of solution at the cathode surface faster than it is being replaced. The relative proportions of free caustic and cyanide versus zinc controls to a large extent the rate of dissolution of the anodes, and when plating deeply recessed parts having threaded portions in what would be a high current density area on the part, it may be desirable to sacrifice efficiency and use a low metal concentration with a high plating current, since this combination will provide a more uniform distribution of deposit. Metal concentration and efficiency are related factors in many commercial installations because agitation cannot be employed, due to a lack of facilities for filtering the plating solution. In this case the solution must be kept as dormant as possible so that solid impurities which might be occluded in the deposit are enabled to settle out.

In barrel plating, higher metal concentrations are recommended, in spite of the low current densities and agitation inherent in this method of plating, because it is difficult to replenish the solution within the barrel. Higher concentrations of metal also help to minimize overheating, a troublesome factor in barrel plating, by reducing the electrical resistance of the solution.

Using Addition Agents

The second practice which is recommended to be discarded is the use of addition agents. In the case of organic agents there is little fundamental information available as to their role in the plating operation, whereas our experience with and knowledge of metal agents is substantial. However, in the final analysis the conclusions reached apply to both types of addition agents. In the case of metal agents, the added metal is more expensive than zinc and generally does not contribute in any way to the protective power of the

zinc coating, which protects essentially by a sacrificial action. Also, the plating current is divided between the zinc and the added metal, with the result that not only is efficiency with respect to plating of zinc adversely affected, but even more important, the throwing power with plating efficiency is more severe in low current density areas, a fact taken advantage of in bath purification by electrolysis. In this method, plating is performed on dummy cathodes using low current densities which results in plating out the heavy metals at a much faster rate than zinc.

Let us consider how the practice of using addition agents has come about. In the early stages of the cyanide zinc electroplating game, chemicals and anodes were very impure; these impurities caused no end of trouble. Our experience at *Western Electric* probably illustrates the problem much better than any involved explanation. Over the weekend the bath would purify itself because the heavy metal impurities in the plating bath would deposit by immersion on the anodes. Since deposits obtained from pure solutions have a dull yellowish appearance and are very susceptible to staining, and since bright dips were unknown at the time, this condition was, of course, undesirable. When operations started on Mondays, the impurities, principally lead, started building up in the solution and the deposit gradually became whiter and less susceptible to staining. After considerable study it was decided that one way of eliminating the difficulty was to keep the bath in a constant state of impurity, and the practice of using metal addition agents was adopted.

About 1935, there was introduced a well-known bright zinc plating bath which rightfully took the opposite approach. Instead of trying to keep the bath in a constant state of impurity, the solution to the problem was to keep the bath in a state of maximum purity at all times, and to use a nitric acid bright dip. After this forward step in bright zinc plating practice, the trend was reversed again by the promotion of some new types of metallic and organic addition agents capable of producing brilliant deposits. However, it is one thing to produce a bright attractive zinc plate *and it is another thing to keep it that way!* It is generally accepted that the only way a bright deposit that will not tarnish readily can be retained, is by use of a passivating treatment. Since passivating treatments with excellent chemical polishing action are now available which will produce brilliant surfaces on deposits obtained from high purity solutions, it is certainly a waste of money to add addition agents, either metallic or organic, to the plating bath. In the over all picture they contribute nothing. Electroplaters started to use addition agents before high-purity methods and passivating treatments were available, and even though subsequent developments and accumulated knowledge have indicated that the high purity approach is better, this outmoded practice is retained in many quarters.

Process Control of Bright Zinc Plating

At the Western Electric Co. we have recently adopted two control practices for zinc plating which we feel have resulted in an appreciable improvement in quality. These practices are:

1) Analytical control of the sulfide purifier, and

2) Modified statistical quality control method especially designed for automatic plating operations.

Analytical Control

The analytical control of sulfide is essentially a very simple idea, but it is regarded as one of the major advances in recent years in the field of bright zinc plating because it enables assuring adequate amounts of sulfiide purifier being present to remove the impurities for which it is specific without precipitating an appreciable amount of zinc which may be lost in the sludge or occluded as an impurity in the deposit, or both.

The working concentration of sulfide aimed at is .03 oz./gal. of plating solution. The analytical procedure consists of taking a 25 ml. sample of plating solution and titrating it with a standardized Lead Nitrate Solution prepared by dissolving 7.95 grams of dried lead nitrate in water and diluting to 1 liter in a volumetric flask. The lead nitrate solution is titrated into the sample slowly until a visible precipitate ceases to be formed. The exact end point is determined by placing a drop of lead nitrate solution on a filter paper so that it partially overlaps a drop of the titrated solution. When the end point is reached there is no appreciable difference between the color made by the sample solution and that of the overlapped area. Free sodium sulfide present in the plating solution is .01 times the milliliters of lead nitrate used for the titration.

Statistical Control

The second practice adopted at Western Electric is a statistical technique for automatic platers which is believed to be unique in the electroplating trade. This technique is based on the premise that all controls must in the final analysis be put to work as a team. A final control or test is desirable to determine how well this is being done. Western's modified quality control method of doing this was introduced to the American Electroplaters Society in a paper presented by *Dr. R. E. Barr* at the Annual Convention in Milwaukee in 1949. Complete details are given in this paper. It consists of a systematic method of inspecting product and setting forth the data as they accumulate in such a way as to provide a continuous picture of the final total results of all controls used in the plating process.

First, by a selective method of collecting a sample, namely taking the parts to be tested from the center of the plating rack and then making thickness measurements in areas on the part normally having the thinnest coating, a considerable amount of uncertainty usually encountered in random sampling is eliminated. Second, while product is accepted or rejected on the basis of the measurements made on the sample parts, as is the usual practice in any inspection procedure, the process as a whole is also measured for its state of satisfaction by use of a modified control chart.

Figure 2 shows the control chart and the inspection plan used. As shown in Fig. 2, two values are plotted, the thickness of coating on the part in a sample of five parts having the thinnest coating, and the thickness of coating on the part in the same sample having the intermediate or median thickness. The former is

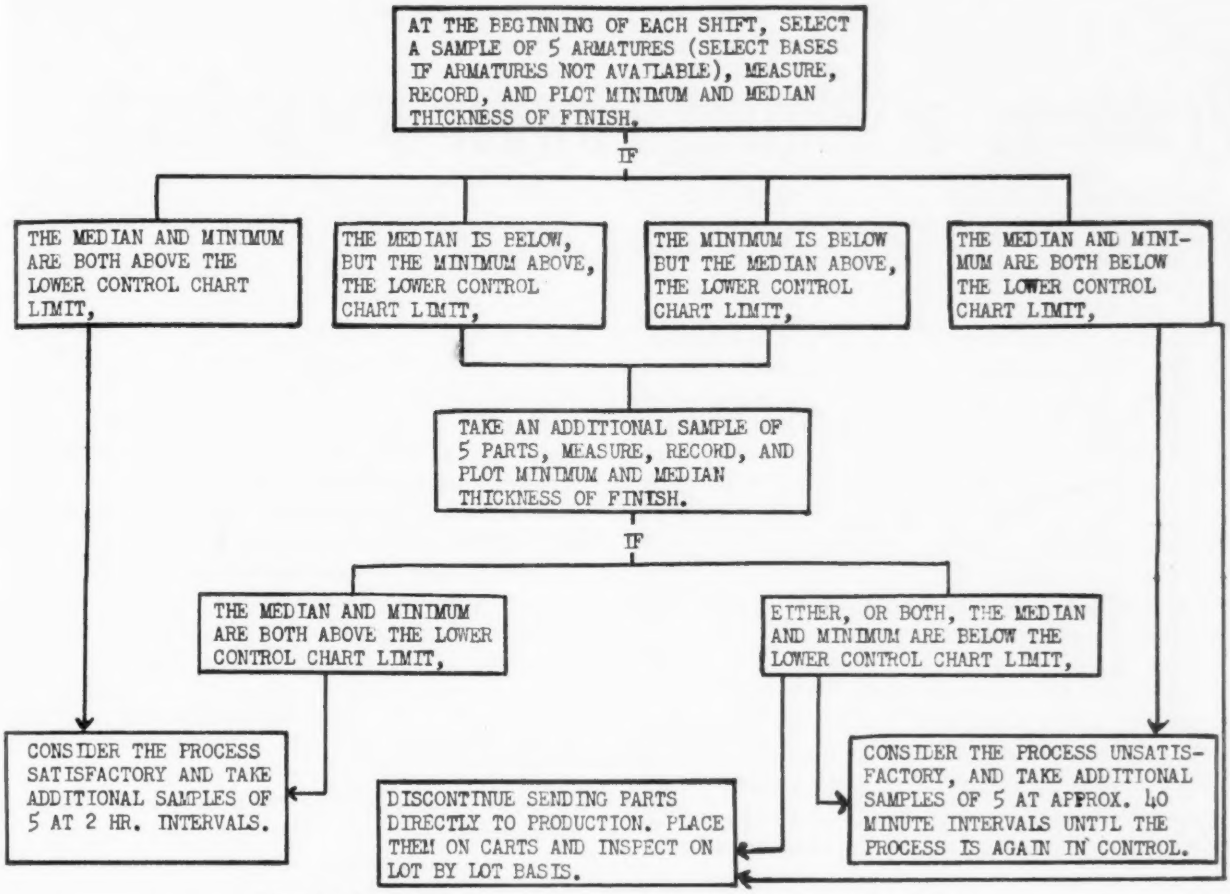


Figure 3. Flow Chart of Process Control Procedure for Inspection of Zinc Plating.

recorded because minimum thickness is an inspection requirement and is important from the standpoint of corrosion protection. The latter is recorded because it is a more stable index of overall quality level. As these data are accumulated on the charts, successive points are joined together by lines.

Now this is the valuable feature of the control chart: by watching how the line fluctuates, whether it is a steady climb or descent, whether it follows some systematic pattern, or whether any pattern it has been following changes, an indication is obtained as to how all of the direct controls are functioning as a team. Some of these possibilities have been consolidated in Fig. 2 for purposes of illustration. At Section A, even though the inspection requirement has been met, since the corresponding minimum point is above limits, the process is considered unsatisfactory because the median is below the lower limit line for medians; this indicates that the overall quality level is low, with a good possibility that the minimum requirement was met by accident. At Section B, the trend is constantly down and trouble can be expected if corrective action is not taken. At Section C a cyclic variation occurs and this should be taken as a warning that one of the mechanical controls, for example, the heat exchanger controls, may be out of adjustment. At Section D, the measuring instrument probably needs attention because both minimum and median are the same and if results are as shown at Section E it would probably be wise to check the inspector because such consistent results near the minimum point are not normally expected.

From an overall standpoint, the principal advantage of this treatment of inspection data is that it enables the plating operator to anticipate possible impending difficulties and take corrective action before rejections are encountered which would seriously hamper production. Also, this visualization of the process as a whole cautions the operator against taking some drastic corrective action indicated by one of the individual controls which may not be functioning properly. For example, when an analytical result would indicate that a heavy addition of some bath constituent is required, the fact that the control chart line has shown no unusual change would suggest first a recheck of the analysis and if the previous result is substantiated then a thorough investigation of the process.

Figure 3 shows how the overall inspection plan operates. If both median and minimum are within the limit lines for each on the control chart, the process is considered satisfactory from the inspection standpoint and is not checked for two hours. If either one is below limits, the production people are immediately notified, and after allowing them 20 minutes to take corrective action, the process is re-sampled. If the condition has been corrected, inspection returns to the two hour plan. However if one or the other is again below limits, all product is inspected on an intensive lot-by-lot basis until subsequent checks show the process back in control. If in the first sample both are below limits, the lot-by-lot plan is resorted to immediately. Finally, if either or both minimum and median are above limits the shop is required to take corrective action. Besides being wasteful, excessive deposits may lead to assembly difficulties, since many of the parts being plated have tapped holes.

Problems of Plating Powder Metal Parts

By J. D. Shaw, W. V. Knopp and C. L. Clark, *S-K-C Research Associates, Paterson, N. J.*

THE field of powder metallurgy has grown considerably in the last decade and will continue to grow. With this growth, a larger variety of powder metal parts are being made, many of which will be subjected to a plating operation.

The problems encountered in attempting to plate a metal powder part are numerous, and this discussion must therefore be somewhat limited. In the course of practical application of plating processes to powder metal parts other problems will arise which are not covered herein.

The Nature of Powdered Metal Parts

Any paper concerned with the plating of powder metal parts must necessarily go back to some of the fundamentals of powder metallurgy. By definition, powder metallurgy is "the art of producing metal powders and shaped objects from individual, mixed or alloyed metal powders, with or without the inclusion of nonmetallic constituents, by pressing or forming objects which are simultaneously or subsequently heated to produce a coalesced, sintered, alloyed, brazed or welded mass characterized by the absence of fusion, or the fusion of a minor component only." To the layman, this means that if powder is compacted under relatively high pressure, and then either heated during the pressing operation or after the pressing operation has been completed, the powder particles will be bonded in a more or less homogeneous mass. If any melting does occur, it will not change the shape or dimensions of the piece to any appreciable degree. This operation can, therefore, be said to be in great contrast to the normal metallurgical processes of melting and casting. The starting material may be a single powder, or a variety of powders, or these powders may be more or less alloyed together, depending on whether a complete alloy or just a partial alloying of certain of the constituents is ultimately desired. It is common knowledge, of course, that if one of the constituents melts, the alloying or diffusion will proceed at a much more rapid rate than if no melting occurs. (In the latter case, it is necessary to depend on solid-to-solid diffusion.)

Another characteristic of powder metallurgy parts, and the one of most importance to platers, is the fact that they are more or less porous; some intentionally so, and others as a result of the nature of their processing. For example, during the pressing operation, lubricants are often added which volatilize during the sintering (heating) operation, leaving behind voids. It is entirely true that if a part is sintered for a long period of time these voids will diminish in number and then in size until they disappear, leaving a dense mass. The time of sintering required for such an operation to occur is far beyond the practical limits, however. Furthermore, when a mass of power is compacted, the only way the density can be increased is by applying more and more pressure. There are, however, limitations to this. In practice, what is done is simply to apply adequate pressure to make the part sufficiently dense to withstand the stresses to which it will be subjected. If the pressure is increased to obtain an increase in density, costs go up to a point where it may be impractical from an economic standpoint to make the part by powder metallurgy. Furthermore, for all practical intents and purposes, there is a maximum effective pressure (i.e., no matter how great a pressure is applied beyond this limit, no appreciable increase in density is obtained). Unfortunately, in the cold pressing operation, voids may still be left in the part under the maximum pressure that can be economically and practically employed.

Using the foregoing as a premise, the types of powder metal parts which are made can be broken down into three general classifications. These may be called for simplicity; (a) porous parts; (b) dense parts and (c) intermediate parts. The following comments can be made about these groups from the standpoint of plating.

Porous Parts

Certain powder metallurgy parts are made porous intentionally. To the powder combinations which go to make these parts are added lubricants and volatile agents to increase the porosity beyond that which would normally be created in the part by conventional pressing and sintering conditions. Typical of these are the porous bronze bearings called "oilless" or oil containing. It is an inherent qualification of these parts that they must have porosity to function properly. As regards plating, if such parts were to be plated (which fortunately is seldom required) it would seem more feasible to plate the particles of powders, if possible, rather than to plate the finished object. Even under optimum circumstances, a considerable percentage of the voids would be covered during any plating operation, and this condition would result in an impairment of the actual functions of such parts.

Since it is an advantage to have as much open network within such compacts as is feasible, if it is necessary for these products to be used in a corrosive or erosive atmosphere or liquid, experience indicates that they should be made of corrosion or erosion-resisting powder materials, rather than depend on a plated surface for these properties.

Dense Products

While up to now the number of fully dense parts

made has been relatively small, some have been produced. In certain metallic combinations, one component has a capillary attraction for the rest of the material and will tend to cause the compact to shrink and become fully dense. An example of such material is the hard cemented carbide, where cobalt is the matrix material. Another powder metallurgy process which produces dense parts is that of hot pressing where the compact is subjected to simultaneous application of heat and pressure which allows it to reach substantially full density within the practical limits of pressure. These latter parts are becoming of more and more interest, although as yet they account for only a very small percentage of the total of powder metallurgy products.

Finally, another operation which does not produce a fully dense part, but which produces a part which has a very dense and practically impervious surface, is that of coining. Reference here must be made, however, to the fact that the term "coining" can be used in several degrees. Pressure can be applied sufficient only to alter the contour of the piece of a slight degree; or it can be applied sufficient to alter the entire surface so the exposed face pores will be closed and the part will, for most intents and purposes, act as a structure with a solid non-porous surface. This is one of the peculiarities of a powder compact as contrasted with massive metal, or even as contrasted with the pressure applied to a liquid. If pressure is applied to a solid structure or to a liquid, it will be transmitted throughout the media; in pressing a porous metal compact, however, the major part of the pressure will be absorbed at the surface and result in closing the pores. Not until the surface pores are closed will the pressure be transmitted to any large extent to inner sections of the compact. In all three of these operations, a dense surface structure is the end result. The job of plating such structures is no different from that of plating a cast, wrought, forged or machined part. In other words, plating of a powder metal structure with a dense surface would be handled by the same technique as would the plating of any massive part.

Intermediate Porosity

These parts are the ones which are not intentionally porous, but which do have a certain degree of porosity as a result of the practical limitations placed on the processing (which means they may be anywhere from 85-95% of theoretical density) and because they must be made at a relatively low cost and from a relatively inexpensive material. In this category would fall the so-called powder metal machine parts, the parts which are being substituted on a straight cost basis for parts made by other processes. These machine parts not only have porosity within the compact, but they also have a certain amount of surface porosity.

In most cases, it is not practical from a cost standpoint to coin these parts in order to close over this surface porosity. A number of methods have been attempted for plating such parts, with most of these methods being based on closing the surface porosity by some manner or means so that plating can be done over the surface without penetration of plating solution into the pores of the compact. The methods of closing the surface of a compact include those of physically working the surface, of coating it with some compound, and of heat treating the compact to fill up the surface voids and make the part amenable to conventional plating.

Since the largest category in metal powder parts is the intermediate one where there is unintentional porosity, parts of this type have received the greatest attention in respect to plating. A number of papers have been prepared on the subject of plating of powder metal parts and are cited at the end of this report. Two of the articles describe methods which are used in practice; (a) that of heat treatment of the surface, used for ferrous parts and (b) that of mechanically working the surface, for brass powder parts. Both methods have been used with some degree of success, although both are fairly new. These two methods are briefly described in the following paragraphs.

Kuzmick[1] suggested a process of plating powder metal parts directed toward eliminating the "spotting out" condition normally encountered. The methods used involve heat treatments to remove residual plating salts. In his description, he states that the plating of porous metal parts involves a number of special problems among which are: (1) the fact that pressed and sintered parts have a velvety rather than a glossy finish, due to their irregular surface, and the surface porosity makes it difficult to obtain a uniform deposit of plating metal, (2) the difficulty of completely sealing the surface of such parts by plating them and (3) the danger of internal corrosion caused by entrapped liquids or salts from the electrolyte.

A proprietory method of plating powder metallurgy parts called "Etolizing", was developed to overcome these difficulties. Actually, three methods are possible; (1) the electroplating of a "green" unsintered compact, followed by washing, a neutralizing acid dip if required, and then sintering the compact in the conventional manner, (2) the short presintering of a "green" compact to increase its handling strength and clean its surface, followed by electroplating, washing and dipping if required, and finally subjecting the compact to the full sintering operation, (3) the electroplating of a fully sintered part, followed by washing, acid dipping if required, and then a short heat treatment to volatilize residual salts from the pores. Essentially, it is claimed that method (1) can be used for high green-strength pieces, (2) is good for both thin and heavy section parts and (3) is particularly adaptable for parts which are to be oil impregnated for self-lubrication. Photomicrographs of cross-sectioned plated structures and typical pieces are shown in the article.

Scott[2] describes work conducted on plating at *The Illinois Lock Co.* The parts plated were brass lock parts which were given a chrome plate.

The porosity in the metal powder parts is reported as the main source of difficulty encountered. Reduction of the surface porosity by impregnation, re-coining and hand or mechanical burnishing were found to be impractical from a cost standpoint. The two types of trouble caused by porosity were eliminated by a set cycle and resulted in successful plating of the brass powder parts.

The low conductivity of the metal part was the most serious difficulty. With low conductivity it was difficult to obtain uniform distribution and adhesion of the nickel and chrome coatings. A base coating of copper plate was used.

The porosity also resulted in retained oil and acid in the pores which makes extremely thorough cleaning methods necessary. If not thoroughly cleaned, the plating will be attacked from underneath immediately and the plate will soon flake off.

Development work done at The Illinois Lock Co. eliminated these two difficulties by a cycle which included a base coat of copper and a variety of cleaning steps, all of which were very carefully controlled.

A third article of considerable interest was that prepared by *Graham, Pinkerton, Anderson* and *Reinhard*[4]. These co-workers studied the plating of powder metal parts at the *New Jersey Zinc Co.* by running a series of preliminary tests on the plating of 85-15 brass parts with nickel-chromium and copper-nickel chromium. The chief difficulties were "drag-out," i.e. contamination of plating baths by material retained in the pores of the compact, and "spotting-out," i.e. corrosive reaction between the electrolyte retained in pores and the plate. These difficulties were attacked, with varying degrees of success, by the following steps in various combinations:

A. Mechanical Working of the Surface
B. Elaborate Cleaning and Rinsing Operations
C. Copper Plating
D. Buffing of Copper Plate
E. Copper Cleaning.
F. Plating with Nickel or Nickel-Chromium.

The test results, which were somewhat inconclusive, are summarized by Graham, et al. as follows:

1. The procedures described applies to 85-15 brass.
2. The actual plating area is much larger than was calculated because of voids and surface porosity, as was demonstrated when an attempt was made to plate to a predetermined thickness.
3. Variations in compacting pressure were not found to be important, although slightly denser compacts were more troublesome to process successfully, probably because of greater difficulty in cleaning and rinsing relatively smaller pores.
4. The following precautions were investigated in an attempt to prevent "drag-out" with consequent contamination of plating solutions:
   a. Prolonged cold water rinsing (not satisfactory).
   b. Alternate hot and cold water rinsing (better than (a)).
   c. A weak neutralizing dip prior to hot and cold rinsing was most effective in reducing "drag-out" and also aided in preventing "spotting out."

It was found that "drag-out" with standard untreated specimen may be ten times that with a similar piece treated to reduce surface porosity.

It was found necessary to use a good anodic alkali cleaning agent in the cycle if pores were to be cleaned effectively.

The following methods of closing surface porosity were investigated:

1. Impregnation — cost made it impractical.
2. Mechanical Working
   A. Hand burnishing — effective.
   B. Re-pressing
   C. Ball burnishing.
   D. Polishing or buffing.

It was found that (D) was most effective, followed by (C) and (B) in that order.

It can be readily seen that the plating of powder metal parts presents problems of considerable magnitude, particularly where a part contains porosity.

It would seem that a plating technique for porous powder metallurgy parts must be worked out for each individual case. The porosity of the powder metal part is the factor that creates the problem in the plating process. When the conventional plating techniques are used, two types of difficulties are encountered as a result of the porosity; a) the porous part is low in conductivity, which makes it difficult to obtain a uniform distribution of plating, and b) the retention of oil and acid in the pores results in "spotting out."

In conclusion, it can be said that, while the plating of powder metal parts presents many problems, many advantages may accrue from such plating. A proper plating will (a) retain the color, luster and appearance of the part, (b) protect the base metal from corrosion and against any specific chemical reaction and (c) protect the part against wear and abrasion. It is to be expected that the effect of plating would be much more startling on powder metal pieces than on conventional materials, since a powder metal part presents a potentially greater surface available for corrosion as contrasted with parts made by other means.

As a result of emphasis on the value of plating powder metal parts, developments in the future may make it possible to put a coating on the surface of a compact which will render this compact impervious and yet will allow conventional plating. However, the present difficulties of plating porous powder metal parts should not be minimized. Powder metal parts are frankly at a considerable disadvantage in this respect as compared with other materials, and many times it may be less costly to use a more expensive starting material and omit plating if a special corrosion resistant finish or decorative finish is desired. Under any circumstances, cost will play a major role in deciding whether or not a powder metal part is to be plated.

References

1. Kuzmick, Jerome F., "Metal Powder Parts Successfully Plated by New Process," *Materials and Methods,* June 1950, p. 55.
2. Scott, Paul K., "Powder Parts, Machined and Plated," *Iron Age*, April 20, 1950, p. 87.
3. Graham, A. K., Pinkerton, H. L. Anderson, E. A. Reinhard, C.E., "Plating of Pressed Metal Powder Parts," *Plating*, July 1949.
3. Hausner, Henry H., "Some Notes on the Electroplating of Powder Metallurgy Parts," *Metal Finishing,* March 1950, p. 73.
5. Bonanno, J. L., "Powder Metallurgy from the Design Engineer's Viewpoint," *Proceedings of the Metal Powder Assn.,* V. 1948, p. 74.
6. Wulff, John, "Powder Metallurgy," Book — American Society for Metals (1942).

Dragout Control—Part I

By Joseph B. Kushner, *Director, Kushner Electroplating School, Stroudsburg, Pa.*

THE earliest studies on the subject of dragout were made, naturally enough, in connection with the conservation of materials.[1,2,3,4] Except for a few advanced shops, little attention was paid to these pioneering papers at the time since in those days the industry considered as insignificant the husbanding of materials in quantites as small as these.

Now that there is a great hue and cry about waterway pollution, dragout has come into the limelight once again because the little drops of plating solution that cling to the work as it comes from the bath foul up rinse water, and fouled-up rinse water is what helps poison our streams. This being the case, and since the plating industry has belatedly become conservation conscious, it seems appropriate that we exhume the results of some of these studies and examine them closely, in the light of recent developments.

At the start, to avoid any ambiguity, let us define dragout as "the *volume* of solution carried over the edge of a plating or dip tank by an emerging piece of work." We can speak of the dragout per square foot of surface, per piece, or per load — it makes no difference as long as the meaning is clearly stated and the unit is used consistently throughout. In this discussion the unit will be taken as dragout per square foot of surface. Further, for the sake of simplicity, in the theoretical considerations which follow, mechanical capture of solution such as is caused by cup shapes, hollows and openings, will be temporarily disregarded.

Some Dragout Theory

Let us consider a flat metal strip of width "a" and length "b" that is withdrawn vertically from a plating solution at a velocity "U", as indicated in Figure 1. What will determine how much plating solution is carried over the edge of the tank by this metal strip?

Obviously, there are two distinct yet not completely separate phases of the phenomenon to be considered. During the first phase, the strip is moving out of the main body of liquid but is still in contact with it. This can be called the *withdrawal* stage. During the second phase, the strip has broken away from the main body of liquid and drainage is taking place as the strip now begins to move towards the edge of the tank. This can be called the *drainage* stage.

The withdrawal stage, clearly, is the most important part of the process because the thickness of the clinging liquid film, which is in turn a measure of the total amount of solution carried, is determined during this period. Accordingly we will analyze this phase first.

What will determine the thickness of the liquid film? There are several factors involved and their relationship is complex. The factors are the velocity of withdrawal, the viscosity of the solution, the density of the solution, the acceleration of gravity and the surface tension. From Figure 2, it can be seen that the most important forces involved are 1) the shear-resisting force of viscosity, and 2) the lifting force which imparts a velocity "U" to the clinging liquid against the viscosity force and the force of gravity. While surface tension plays a part, its effect is small as compared to these other forces.

If we assume that surface tension can be neglected during this stage, we can set up a dimensional equation for the thickness of the film, "f", provided it is a function of the product of the forces involved. Such an equation is,

$$f = KF(U\phi dg) \qquad (1)$$

K = *unknown constant*
F = *function of the variable*
U = *Velocity of withdrawal*
ϕ = *viscosity*
d = *density*
g = *acceleration of gravity*

Using the well known procedures of dimensional analysis in which both sides of the equation are equated in terms of the fundamental units of mass, length and time, we have

$$L = K\,[L/T]^m\,[M/LT]^n\,[M/L^3]^o\,[L/T^2]^p \qquad (2)$$

Equating the like terms results in a series of 3 equations in 4 unknowns, m, n, o, p. Solving them in terms of 1 unknown, m, results in,

$$f = K\,[U\phi/dg]^m \qquad (3)$$

To put it in words, the thickness of the liquid film is equal to a constant multiplied by the mth power of the velocity, multiplied by the viscosity, divided by the density and the acceleration of gravity.

What K and m are can only be determined by experiment or some facts outside of the dimensional analysis. Unfortunately, as far as the writer knows, no work of this type has been done in the U. S. However, in 1936 *Soderberg*[3] presented to the American Electroplaters Society a comprehensive paper on dragout in

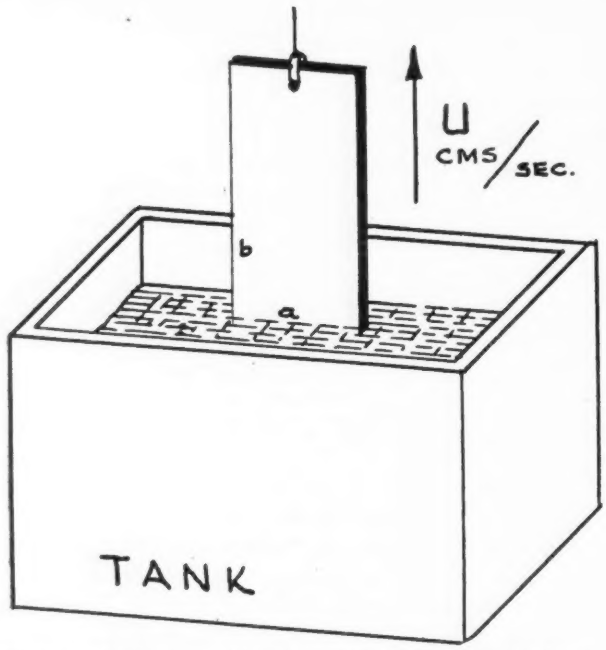


Figure 1. Schematic model used for calculations on dragout theory.

which he gave several correlations between the time of removal of a flat metal strip from a zinc plating solution, and the dragout, and obtained a series of curves of the type shown in Figure 3. The data on which the curves are based combine the two distinct phases of removal and drainage so that they cannot be separated. Nevertheless, for longer removal times (lower velocities) and the shortest drainage period used (2 seconds) for which figures are given, it is possible to use some of the data to determine the value of m, in equation 3 above.

The curves have the general form of rectangular hyperbolas and therefore the product of the dragout "e", multiplied by the time of removal "t", should be approximately constant if the film thickness varies directly with the velocity of withdrawal [$U \propto 1/t$]. If this is not the case then the product $\ominus t^m$, should remain constant if the film thickness varies with the mth power of the velocity of withdrawal, U.

The first two columns of Table 1 give Soderberg's figures for a strip 2″ x 12″, and alongside are the products $\ominus t^m$, calculated by the writer.

Table 1

Time of Removal t (seconds)	*Dragout Volume $\ominus$ (ccs)*	*Product $\ominus t$*	*Product $\ominus t^{2/3}$*	*Product $\ominus t^{1/2}$*	*Product $\ominus t^{1/3}$*
6	3.20	19.2	10.55	7.85	5.80
8	2.70	21.6	10.80	7.65	5.40
10	2.40	24.0	11.05	7.60	5.18
15	1.95	29.2	11.75	7.55	4.82
20	1.70	34.0	12.40	7.60	4.60

As can be seen the product using $m = 1/2$ gives an approximately constant value whereas powers greater than $1/2$ give products that increase and powers less than $1/2$ give products that tend to decrease. Accordingly, we can write as a result

$$(4) \qquad f = K\,[U\phi/dg]^{1/2}$$

A Russian experimenter by the name of *Deryagin*[5] performed some research on the thickness of liquid films on surfaces withdrawn from the liquids, during the period 1944-1945, and gave as a result, the following equation:

$$(5) \qquad f = \left(\frac{s}{dg}\right)^{1/2} \times {}^{3/2} F.x$$

where $x = [U\phi/s]^{1/3}$, "s" being the surface tension, and the other variables having the same meaning as before. "F.x" is a function of "x" having the following properties: As "x" gets larger than than 1.1, then "F.x" approaches unity, and as "x" approaches zero then "F.x" approaches the value $.94\,[U\phi]^{2/3}$. If the two limiting cases are worked out, the *average* film thickness "f", is given by

$$(6) \qquad f = \tfrac{2}{3}[U\phi/dg]^{1/2} \quad \text{where x 1.1}$$

$$(7) \qquad f = \frac{.94[U\phi]^{2/3}}{[dg]^{1/2}\, s^{1/6}} \quad \text{where x 1.1}$$

It can be seen from equation 7 that even where surface tension does enter the picture it has little effect because it appears only as a sixth power. Thus a significant change in surface tension reflects little difference when the sixth root is taken.

In comparing the equations proposed by *Deryagin* and the one developed by the writer with the aid of dimensional analysis, a rather strange anomaly crops up. Equation 4 agrees perfectly with equation 6, yet according to *Deryagin*, for equation 6 to hold, $[U\phi/s]^{1/3}$ must be greater than 1.1. The solution used by *Soderberg* was a typical zinc cyanide solution, the viscosity of which can be approximated as .2 poise and the surface tension of which can be taken as roughly 70 dynes. The velocity of withdrawal in the range for which the figures were used, varied from about 2 to 6 cms. per second. This being the case, the criterion is equal to $\left[\frac{6x.2}{70}\right]^{1/3} \cong .22$ which is quite a bit smaller

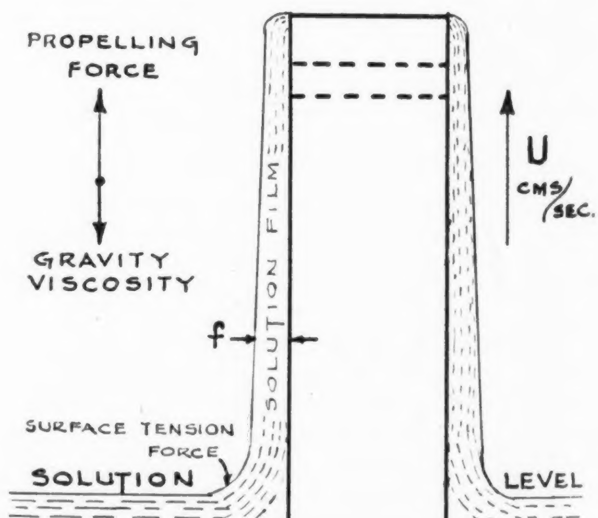


Figure 2. Illustrating the various forces at work during removal of object from plating bath.

than 1.1 and equation 7 should be the correct one to use. Yet, as can be seen from Table 1, a constant product was not obtained when the two thirds power of "U" was used as a multiplier. The excellent correlation between equations 4 and 6 and Soderberg's figures leads this writer to believe that those two equations are more likely to be correct for this case.

A further verification of equation 4 is possible through the use of plating solution viscosity data, if such exists. In a paper presented to the *American Electroplaters Society* in 1938, *Hull*[6] gave some figures on the viscosity of certain plating solutions and dragout loss. A series of curves were given which indicated that the dragout loss varies directly with the viscosity of the plating solution. Close examination of the data presented shows that the straight lines are based on only two sets of data points for each curve. Only for one curve, that for a cadmium solution, are three points given. These three points appear to lie on a straight line and for this reason, no doubt, it is assumed that dragout loss varies directly with viscosity. However, buried in the data are figures which prove that the film thickness (a measure of the dragout loss) varies with the square root of the viscosity (equation 4)!

Equation 4 states $f = K[U\phi/dg]^{1/2}$. Therefore if dragout losses are measured at two different viscosities, assuming the velocity of withdrawal is the same in each case, the ratio of these losses would be to each other as

$$\Theta_1/\Theta_2 = [\phi_1 d_2/\phi_2 d_1]^{1/2}$$

since the density of the solutions change when the viscosity is changed and only U, K and g are constant.

In one experiment, a cadmium solution was used of the following composition:

Cadmium hydroxide	44 grams per liter
Sodium cyanide	130 " " "
Cobalt sulfate	10 " " "
Organic brightener	1.4 " " "

To this solution varying amounts of sodium carbonate were added and the dragout loss, using a standard procedure, was determined for each concentration of sodium carbonate. The viscosities of the solutions were measured with an Ostwald viscosimeter. The data given is as follows:

Concentration Sodium Carbonate (Oz./Gal.)	*Viscosity (Poises)*	*Dragout Loss Fluid oz./100 sq. ft.*
0	.0129	8.6
10 (75 g/l)	.0212	9.9
15 (112 g/l)	.0263	10.8

The specific gravities of the solutions were taken but are not given in the paper, so that some approximations will have to be made.

The change in specific gravity on the addition of 5 extra oz. of sodium carbonate per gal. to the solution containing 10 oz. is necessarily a small one, therefore these two points can be safely used for checking equation 4. We have then that

$$\frac{9.9}{10.8} \cong \left[\frac{.0212}{.0263} \times \frac{d_2}{d_1}\right]^{1/2}$$

If d_2 is only slightly greater than d_1 then their ratio may be taken as unity. This being so, then evaluation

Figure 3. Typical dragout-removal time curve.

of the term on the right gives .90 and the term on the left gives the value .92! Actually the term on the right should be slightly higher than .90 because the ratio of d_2/d_1 is slightly greater than unity. At any rate, the ratios are close enough to indicate that the variation is with the square root of the viscosity and not the first power.

As another check we can take the figures given for 0 oz. per gal. and 15 oz. per gal., and approximate specific gravities. The cadmium solution as given contains about 180 grams per liter of solids and the specific gravity can be taken as being approximately 1.146. The addition of 112 grams per liter of sodium carbonate will increase the specific gravity to about 1.250. Then we have,

$$\frac{8.6}{10.8} \cong \left[\frac{.0129}{.0263} \times \frac{1.250}{1.146}\right]^{1/2}$$

$$.79 \cong .73$$

The difference, a matter of 8%, is well within the experimental errors, so that the agreement is more than coincidental.

A further verification of the viscosity relationship is in the temperature data obtained by *Soderberg*. He gives, for example, 2.10 ccs. as the dragout of a strip 4″ x 12″ that has been removed in 3 seconds, with the plating solution at a temperature of 25°C. With the same conditions, except that now the solution is at a temperature of 35°, the dragout is 1.97 ccs. Within this temperature range the ratio of the change in viscosity of the solution may be safely taken as being the same as the ratio of change of viscosity in pure water, the solvent used. At 25°C. the viscosity of water is .89 centipoises. At 35° it is .72 centipoises. Therefore

$$\frac{1.97}{2.10} \cong \left[\frac{.72}{.89} \quad \frac{xd_2}{d_1}\right]^{1/2}$$

Since the change in specific gravity will be slight for a 10° temperature rise, the ratio d_2/d_1 can be taken as unity. Therefore, the term on the right is equal to .9. Since the term on the left is equal to .94, the viscosity relationship derived in equation 4 is again verified.

(*Concluded on page* 64)

The Use of Glycerine in Metal Finishing

By E. Scott Pattison, *Manager, Glycerine Producers Assn., N. Y. C.*

METAL finishing is one of the many industries in which glycerine has attained an outstanding reputation for facilitating production and improving results. Progress in the field has called glycerine into use in many of the newer finishing methods by which better finishes are obtained at marked savings in both man-hours and materials — no mean consideration in these crucial days of defense preparation.

Electropolishing

Perhaps nowhere is glycerine's usefulness in metal finishing more evident than in several widely used electrolytic processes, one of which is electropolishing. The solutions used in this process are generally acidic and contain certain organic materials, among which glycerine is prominent.

Glycerine first attained pre-eminence as a major component of phosphoric acid baths for polishing stainless steel. Subsequently, its value in baths based on sulfuric acid was confirmed in both laboratory investigations and plant operations. Its use in baths for electrolytically polishing aluminum and other nonferrous metals is growing steadily.

In a recently developed process for making and finishing stainless steel spinning jets for extruding rayon, the blank is first polished by making it the anode in an electrolytic bath consisting of 40 to 50 per cent phosphoric acid and 60 to 50 per cent glycerine. A current density of 0.1 to 2.0 amperes per square inch is used at a temperature of from 40 to 125°C. Orifices are then drilled through the jet faces, and the unit again submitted to electrolytic anodic action in the glycerine-phosphoric acid bath. This process is said to supplant time-consuming machine work and to give a smooth finish and high polish throughout the orifices.

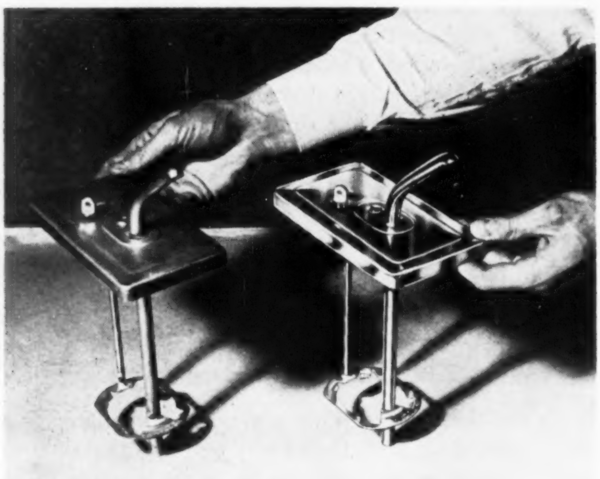


Figure 1. Stainless steel soda fountain parts before and after electropolishing. Glycerine is an important ingredient in the polishing bath.

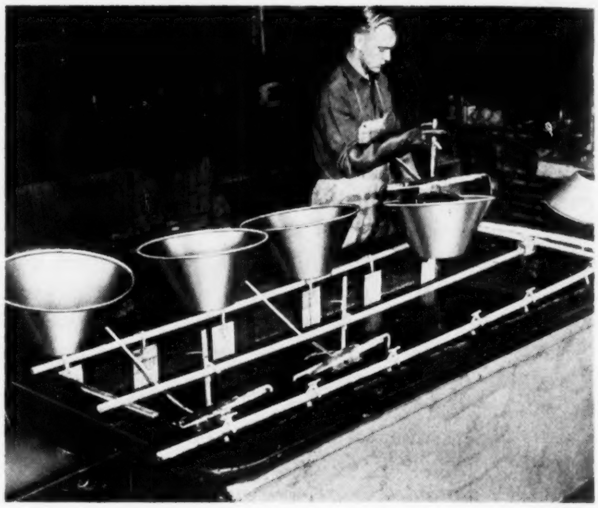


Figure 2. Stainless steel television cones being electropolished. Clean smooth surface is necessary to promote good seal between cones and the glass. Polished in a glycerine-containing bath.

Electrolytic polishing is particularly suitable for objects not readily adaptable to mechanical polishing. This point is well illustrated in a recent method for electrolytically polishing stainless steel hypodermic needles in a solution consisting of:

Sulfuric acid (sp. gr. 1.84)	4 parts
Glycerine (sp. gr. 1.26)	2 "
Water	3 "

With the lead tank lining as the cathode, the needles are anodically polished at 30 to 35°C. with four amperes direct current under 15 volts. It has been found that simultaneously polishing a number of needles shortens the life of the solution but markedly increases work efficiency. The addition of fresh solution, after filtration of the used one, not only regenerates the latter but also helps to stabilize electrolytic action.

It is pertinent at this point to note that various metallurgical studies, including electron-refraction observations, have shown electropolished surfaces to be more resistant to corrosion than those polished by mechanical means. The specimens used in these tests were of stainless steel which had been polished in a solution of equal parts glycerine, sulfuric acid and water.

Some glycerine-containing solutions may be used for polishing both ferrous and nonferrous materials. In one process, brass, bronze, copper, cobalt, and nickel, as

well as ferrous metals, are anodically polished in an aqueous solution of an alkali metal salt of boric, thiosulfuric, or orthophosphoric acid, and a water-miscible organic alcohol such as glycerine. In this process, the work, or anode, is chilled during the electrolysis.

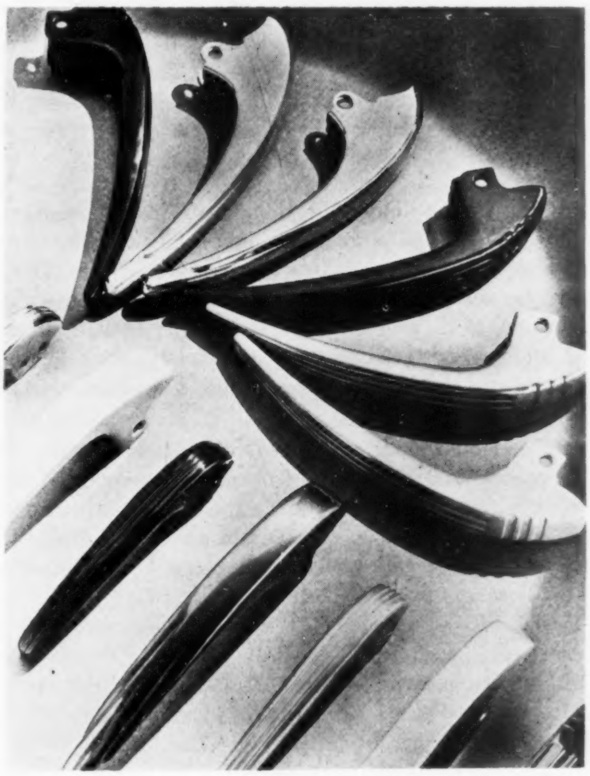
Other electropolishing processes also make use of glycerine-containing baths. *Walton*[1] noted an apparent correlation between the efficiency of electrolytic polishing of copper and the viscosity of the anodic layer and found that mixtures of phosphoric acid and glycerine are more effective than the acid alone. In a representative process for electropolishing brass on a production line basis, a versatile orthophosphoric acid-lactic acid bath containing nearly 25 per cent glycerine is employed.

Finishing Light Metals

In the field of lighter metals, new processes for forming protective anodic coatings on magnesium and magnesium-base alloys use glycerine in the electrolytic baths. One aqueous bath contains sodium silicate, an alkaline base, and up to 10 per cent of a hydroxy organic compound. Glycerine is among the compounds used for the latter purpose because it contains polar groups and retards the formation of gases, thereby assuring a more uniform coating on the metal surface.

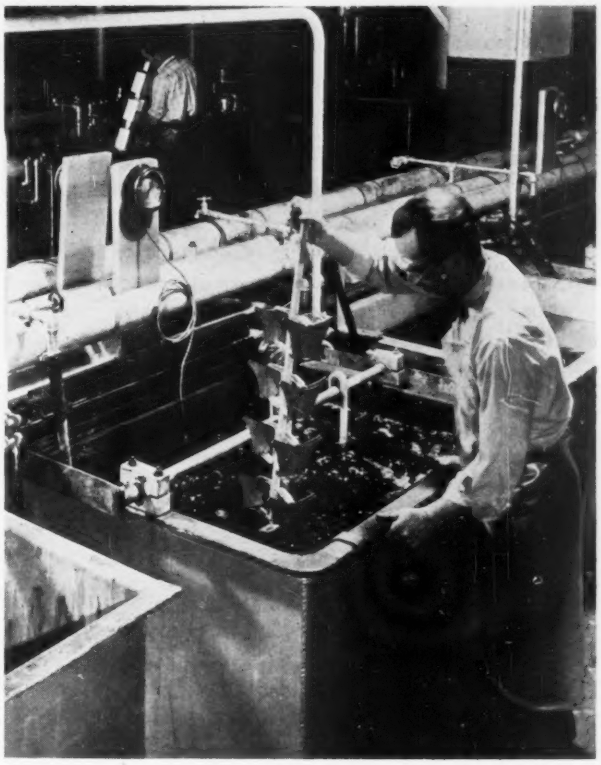
Anodic treatments for aluminum have long made use of glycerine's beneficial action. Newer aluminum treatments include a process for the controlled etching of aluminum in solutions of strontium and barium hydroxides. Up to 10 per cent glycerine is included in these solutions to promote smoother electrolysis.

Even before glycerine's value in electropolishing procedures became recognized, it was used in the electro-



(Photo courtesy Alum. Co. of America)

Figure 3. An assortment of aluminum parts in Alumilite and electroplated finishes. Glycerine is used in the anodizing baths to promote smoother electrolysis.



(Photo courtesy Alum. Co. of America)

Figure 4. Anodic treatment of aluminum parts in a glycerine bath.

deposition of such metals as nickel, cadmium, zinc and tungsten. Several recent patents specify the use of glycerine in the electrodeposition of molybdenum and molybdenum-cobalt alloys. Solutions used for depositing electrolytic coatings of aluminum and aluminum alloys also benefit from the presence of glycerine.

Another example of the value of glycerine in modern processes is *Bennett's*[2] work on the electrodeposition of speculum a tin-copper alloy used in making optical mirrors. He reported that a bath containing 0.1 to 0.5 per cent Perminal COL or a Carbowax and 0.5 to 1.0 per cent glycerine gave bright deposits up to two mils thick, using a current density of 10 to 15 amperes per square foot and a temperature of 80°C. Addition of small amounts of lead, in the range of 0.005 to 0.03 per cent, gave very bright deposits with pronounced smoothness.

Stripping

Electrostripping, the reverse of electrodeposition, is a most valuable process in refinishing operations. During the current preparedness program, it has become an important factor in the salvaging of hard-to-get metals.

In a discussion on the refinishing of hollow ware, (3) for example, the use of a sulfuric acid-glycerine solution has been suggested for stripping chromium and nickel from the base metal. A similar electrostripping solution, recommended by the *Copper and Brass Research Association*, can be used for removing nickel from steel, and chromium from brass, copper, or nickel.[4,5] Glycerine is also useful in controlling the chemical activity of individual components of alloys or metal combinations when other stripping methods are used.

Glycerine also plays a useful role in a method for the

rapid removal of oxide coatings from aluminum surfaces at room temperature without attack on the aluminum itself. The requisite solution is made by passing anhydrous hydrogen fluoride through glycerine until a 5 to 40 per cent concentration is obtained. The resulting solution is used in metallurgical analysis as well as for the removal of oxide films prior to coating and joining operations.

Glycerine may be a useful component of materials for coloring anodized aluminum. In one process[6], direct printing of dyestuffs on the anodic film may be achieved by means of a rubber stereo with a solution containing glycerine. The dyes are fixed by steaming. Compositions for coloring other metal surfaces may make similar use of glycerine. In the coloring of copper and brass articles, Hogaboom[7] suggests using glycerine to promote evenness and to prevent too rapid drying of the color.

Mechanical Finishing

In addition to electrolytic and chemical processes, purely mechanical methods for finishing metals also make use of glycerine's unique combination of physical properties. In the barrel finishing of metal products, particularly in "cutting down" operations, glycerine has two properties that particularly recommend its use. One is its viscosity, by which it maintains the abrasive in suspension and in intimate contact with the parts. The other is its complete and easy rinsibility. This is in marked contrast to the oils which are sometimes used. Glycerine is especially suitable for use with the finer grades of abrasives, such as are employed in final smoothing operations.

Newer barrel or tumble finishing methods utilize rounded fibrous carriers, such as wooden pellets, corn cob granules or the like. These are coated with a glycerine-containing polishing and abrasive compound. Differing basically in the type of abrasive, the coating compositions are made in three grades to fit the chief finishing steps, cutting down, burnishing, and polishing. The following is a typical composition used to coat the fibrous carriers in the burnishing or smoothing step:

Tallow or lanolin	29 per cent
Glycerine	13 " "
Oleic acid	12 " "
Stearic acid	10 " "
Tripoli or other abrasive (320-400 mesh)	12 " "
Chalk, aluminum oxide or other fine polishing powder	24 " "

Abrasives of this kind are said to be superior to older types. They do not cake in the openings and crevices of articles being polished, and they do not create health hazards because of dust.

Many more developments in the metal finishing field can be expected as industry endeavors to meet present-day defense requirements for improved metals and alloys. Glycerine's importance in these developments is assured by its versatility and unequalled combination of properties.

Bibliography

1. Walton, H. F.: *J. Electrochem. Soc.* 97:219, 1950.
2. Bennett, P. S.: *J. Electrodepositors' Tech. Soc.* 26:No. 7, 12 pp., 1950.
3. Haas, J.: *Metal Finish.* 47:49, June, 1949.
4. Black, G.: *Materials & Methods* 23:477, 1946.
5. Anon.: "*Maintenance, Cleaning, Finishing and Coloring of Copper, Brass, and Bronze,*" New York, Copper & Brass Research Assoc. 1948, pp. 18-9.
6. Gill, J. P.: (through) *Light Metal Age*, Sept. 1947.
7. Hogaboom, G. B.: in "*Metal Finishing Guidebook-Directory,*" Ed. 18, New York, Finishing Publications, Inc. 1949, p. 352.

DRAGOUT CONTROL

(*Concluded from page* 61)

The viscosity of a liquid divided by its density is known as the kinematic viscosity of the liquid ($v = \phi/d$). Since "g" is a constant equal to 980, if we use as the constant "K" of equation 4 the value of ⅔ as proposed by *Deryagin* and evaluate we can say with sufficient accuracy for the purpose that

$$(8) \qquad f = .02\sqrt{Uv}$$

That is, the liquid film thickness in centimeters is equal to .02 times the square root of the withdrawal velocity multiplied by the kinematic viscosity of the plating solution.

As an example, if a strip is withdrawn from a plating solution with a velocity of 5 cms. per second and the viscosity of the solution is .02 poise and its density (specific gravity) is 1.200, what is the average film thickness?

$$f = .02\sqrt{5x.02/1.2} = .006 \text{ cms. or about } .0003''.$$

If the velocity of withdrawal is increased to 20 cms. per second, the liquid film thickness will be increased to .0006." On the other hand, increasing the viscosity fourfold does not result in a doubled liquid film thickness, because in increasing the viscosity, the density is also increased, which acts to reduce the overall effect. In other words, the *kinematic* viscosity must be increased fourfold before the liquid film thickness is doubled.

From equation 8 a number of practical results in the control and reduction of dragout losses can be derived. These will be taken up in the second part of this paper, along with a consideration of the drainage phase, in which surface tension plays a considerable part.

References

1. C. F. Nixon, *Monthly Review*, A.E.S., Vol. 15, March 1928.
2. Joseph B. Kushner, *Metal Industry*, January, 1935.
3. K. G. Soderberg, *Proc. A.E.S.*, June 1936.
4. G. B. Hogaboom, *Metal Cleaning & Finishing*, Vol. 8, 1936.
5. B. Deryagin, *Doklady Akad. Nauk*, U.S.S.R. 307-10, Vol. 50 (1945).
6. R. O. Hull, *Proc. A.E.S.*, June, 1938.

Practical Barrel Finishing—Part III

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Introduction

IN the first two installments of this article the variables involved in barrel finishing, and general barrel finishing techniques were covered. At the end of the second installment a very broad and general barrel finishing cycle was outlined. It was pointed out at that time that this cycle may be varied in accordance with the type and condition of the work, and the type of results which are expected.

In this installment metals will be treated individually. Each metal has certain characteristics which make the barrel finishing of it somewhat different. These individual characteristics will be discussed in a separate section for each metal. Sample cycles for obtaining various finishes in accordance with the general cycle are given in the tables immediately following these sections.

Aluminum

Aluminum is one of the most rewarding metals to barrel finish. Due to its relatively soft nature and high reflectivity, bright and sparkling work can be produced with relatively short cycles.

Although many different types of aluminum alloys are made for a large number of industrial uses, as far as barrel finishing is concerned there are only two basic types; those that contain silicon and those that do not. In general all the casting alloys contain silicon, whereas only some of the wrought alloys contain it.

Since aluminum is amphoteric, it may be attacked by both acidic and alkaline solutions. It is, therefore, essential that the solution of the finishing compound have a pH which is near neutral. Aluminum is best cut down and burnished with the aid of a slightly alkaline soap-base barrel finishing compound. (Generally solutions ranging from a pH of 7 to 9 are satisfactory.) However, even in this range there may be a very slight attack on the metal. The longer an operation is carried on, the greater will be the total attack. It is when this attack occurs that the difference between the silicon and non-silicon alloys shows itself. As the aluminum is dissolved, the more noble alloying additions are left behind in the form of a smut. This smut spoils the *color* of the finish (even though the surface smoothness may be entirely satisfactory). The smut left on the non-silicon bearing alloys, consisting principally of copper, may be readily dissolved in a proprietory acidic material or concentrated nitric acid. However, the only solution known to remove a high-silicon smut is the nitric-hydrofluoric acid bright dip. This contains three parts, by volume, of concentrated nitric acid and one part of concentrated hydrofluoric acid. As the reader knows, this mixture is quite hazardous to personnel, difficult to contain, and generally unpleasant to use. Cooling of the solution and adequate ventilation must be provided to remove heat and poisonous fumes which are developed during the bright dip's operation. Due to the undesirable nature of this mixture, generally greater precautions are taken to prevent attack on the cast or silicon-bearing alloy with the thought of avoiding the use of this dip.

Aluminum is prone to discoloration by broken-down media becoming imbedded in the surface of the metal. This discoloration, like the smut formation, is cumulative, and manifests itself more in longer cycles than in short ones. For longer cycles (6 to 8 hours or up) such as are used for finishing castings or for re-conditioning old parts, bright dipping frequently can not be avoided. In such cases, it is best to handle the silicon-bearing alloys in almost the same manner as the non-silicon bearing ones, the difference, of course, being the bright dip used.

Matte Dipping

In the last installment, the advantages of a light matte dip prior to burnishing was discussed. This effect is more noticeable with aluminum than with any other metal. Of course, on silicon-bearing alloys all forms of etching or attack are to be avoided if possible. When this is not possible, however, due to poor stock condition, long cutting-down cycle, etc. it is recommended that full use be made of this effect by first etching the silicon-bearing aluminum alloys in an alkaline solution as with the wrought alloys. This serves to do the majority of the work in the alkali, leaving only the smut removal to the bright dip. This matte dipping on both cast and wrought alloys is identically the same procedure as is employed for etching aluminum prior to painting. A strong alkaline material is employed for the etching and an acidic one for the smut removal. Furthermore, during the violent gassing in the alkaline etching solution, all broken down media dust is removed from the pores of the metal so that a completely white matte surface emerges from the subsequent acidic dip.

The non-silicon bearing alloys are very easily treated in this manner, since the nitric-hydrofluoric acid bright dip is not required. One of the proprietary acid dips, or nitric acid, will remove the copper smut. Therefore, even if only a relatively short cutting down operation is employed, it is often advisable to matte dip before the burnishing when the handling cost will permit it.

This is not only done when the aluminum has lost some color during the cutting down; it is also done because the color obtained on the etched product after burnishing often is better than could have been obtained with the original stock. This entire etching operation should not require more than a few extra minutes.

Barrel Finishing Methods

When barrel finishing aluminum, all the necessary cutting-down should be done employing an abrasive media such as the synthetic aluminum oxide stones discussed in installment 1. Certain parts may be self rolling, but due to aluminum's very light weight and softness, there is very little, if any, cutting action unless an abrasive media is employed. Occasionally, removing an exceptionally large burr or casting mark with an abrasive belt prior to barrel finishing will save a great deal of time in the cutting-down. The work should then be immersed in an alkaline etching solution after cutting-down for one to two minutes, followed by the proper acid dip. Most of the old surface is removed in the alkaline etching solution, with only the smut being removed by the bright dip. Following the bright dipping, burnishing with steel shot is employed for the production of the final luster.

It is possible to do all of the etching in the nitric-hydrofluoric acid bright dip (this is not possible in the straight nitric or in the proprietary bright dips). However, the writer definitely does not recommend this practice since it requires an immersion in the bright dip of from 1½ to 2½ minutes, with the resultant excessive consumption of the solution and the excessive production of both fumes and heat. When preceded by the alkaline etch, a fifteen to forty-five second immersion is quite sufficient.

In those cases where attack can be avoided on silicon-bearing alloys, or when the extra bright color is not required on the wrought alloys, short cycles calling for from one to five hours in the cutting-down stage and thirty minutes to two hours in the burnishing stage may be employed very effectively. Cycles of these short durations frequently do not require bright dipping to remove smut caused by slow attack on the metal in the barrel.

Table 1 — Recommended Barrel Cycles for Aluminum Alloys

Finish Desired	A				B				C			
Stock Condition	Good		Poor		Good		Poor		Good		Poor	
Long or Short Cy.	L	S	L	S	L	S	L	S	L	S	L	S
Clean	1	1	1	1	1	1	1	1	1	1	1	1
Rinse	2	2	2	2	2	2	2	2	2	2	2	2
Cut Down / Deburr	3	3	3	5	3		5		3	3	3	3
Rinse	4	4	4	6								
Clean	5		5									
Rinse	6		6									
Bright Dip / Pickle	7		7	3			3	3				
Rinse	8		8	4			4	4				
Burnish	9	5	9	7		3		5				
Warm Rinse	10	6	10	8	4	4	6	6	4	4	4	4
Hot Rinse	11	7	11	9	5	5	7	7	5	5	5	5
Dry	12	8	12	10	6	6	8	8	6	6	6	6

Notes—Much of the aluminum which is received by the barrel finishing department has been machined or become otherwise soiled. Therefore, steps 1 & 2 are included in the above cycle and constitute precleaning. In those cases where the work received is clean, these two steps may be omitted.

Finishes "A" & "B"—The factor which has the greatest effect on the number of steps is the chemical condition of the stock's surface. Of course, the total number of steps for finish A is greater than for Finish B.

Finish "C"—In this finish the number of steps is the same, regardless of stock condition, since the appearance is not critical. Dimensional changes are not affected by the condition. However, the *lengths of the rolling periods* will not be the same, and are determined by the amount of metal to be removed.

Refer to "General Comments and Key to All Tables" on the following page.

Copper Alloys

Of all the non-ferrous metals used today, more copper alloy parts are barrel finished than all the others combined. This may be accounted for by the fact that the copper alloys are very readily made into the many small parts which are ideal for barrel finishing techniques. Furthermore, the copper alloys are rather tough and not readily damaged by the action of a barrel.

Brasses and Bronzes

In developing cycles for barrel finishing brass parts, it is necessary to consider the condition the brass is in when it is received by the barrel finishing department.

When the chemical condition of the stock is such that corrosion products must be removed, one of two methods may be employed:

1. The corrosion products may be mechanically removed by the action of an abrasive barrel finishing media.
2. When the media is not able to reach all the recesses, or when an abrasive media is not employed (as is the case when certain parts need only to be burnished for bright highlights) the work must be bright dipped.

When the parts are suitably shaped, the first method is to be preferred as being the more economical one.

Depending on the length of the cutting-down portion of the cycle, the bright dipping operation should be either done before any barrel finishing, or between the cutting-down and the burnishing. For cycles employing long cutting-down periods, bright dipping directly before the burnishing is strongly advocated.

In those cases where no tarnish or other corrosion products are on the stock, a pre-cleaning material which will not tarnish the brass must be carefully chosen. This becomes especially important if no cutting-down is to be performed.

When the bright dip is properly inserted into the barrel finishing cycle, there should almost never be any reason for having to bright dip more than once.

There are three major brightening solutions which can be successfully employed on the brasses:

1. The standard chromic acid bright dip (40 oz./gal. chromic acid, 4 oz./gal. sulphuric acid) is most frequently used in barrel finishing cycles. This bright dip produces an entirely fresh surface so that the best possible color may subsequently be obtained by burnishing.
2. A dip in a 2-8 oz./gal. solution of sodium cyanide is occasionally employed to remove *light* tarnish from otherwise good stock. On occa-

sions, one or two ounces per gallon of cyanide have been added to the alkaline pre-cleaner to remove this tarnish at the same time as the soils. Due to the high operating temperatures of the alkaline cleaners, the life of the cyanide addition to them is relatively short and complicates the disposal of the spent cleaning solution.

3. Either a sulphuric or muriatic acid pickle is sometimes employed to remove heat scale. This descaling frequently precedes the chromic acid bright dip.

There are several other bright dips available for use on the brasses, such as the nitric-sulphuric-hydrochloric bright dip. However, most of these have certain objectionable features, such as excessive fuming or heating up, which makes them undesirable when they are not absolutely necessary (see nickel-copper alloys below).

The very natural anxiety of the plater that some chromic acid may be carried through into the plating tank is not warranted when the work is barrel finished. It may be seen that in a very simple barrel finishing and plating cycle there are at least eight steps where any chromic acid will be removed between the time that the part leaves the bright dip and enters the plating tank:

1. Bright dip.
2. Rinse.
3. Burnish for from 15 to 120 minutes in a soap-based barrel finishing compound.
4. Cold rinse.
5. Hot rinse, dry, ship to plating department.
6. Electro-clean.
7. Rinse.
8. Acid dip.
9. Rinse.
10. Enter plating bath.

It is essential that all soldering or brazing flux, as well as other soils, are removed from the surface of the metal before it is barrel finished. These flux residues are often located on the work so that the mechanical action of the media will not remove them. These fluxes will, naturally, interfere with any subsequent plating or will become areas where spotting out can begin, if the work is to be lacquered.

Stamped and drawn parts generally do not require very much cutting, and the cycles for finishing them are mostly under six hours. Castings, on the other hand, may have surface imperfections, parting lines and flash to be removed. These cycles at times call for

GENERAL COMMENTS AND KEY TO ALL TABLES

The tables given after the discussions of each metal are based on the general barrel finishing cycle outlined in the second installment of this series of articles. As many factors as feasible are taken under consideration without making the tables too unwieldy and repetitious.

The variations of the general cycle are based principally on the condition of the stock and the type of finish which is desired. When the work is clean and uncorroded and need only be burnished for the desired finish, fewer steps are necessary than when soils and corrosion products must first be removed, and surface imperfections cut away before burnishing. In those cases where the color or appearance of the work is not too critical and only dimensional changes are called for, any bright dipping and accompanying cleaning and rinsing may be omitted. Various requirements such as the above and others change both the number and sequence of the steps in barrel finishing cycles.

The finishes designated by the letters A, B, C, D, do not correspond to any accepted standard of metal finishes. These letters are arbitrarily assigned to differentiate between the finishes as given in the key to the tables.

Under finish B where the work is either cut down, deburred, or burnished (one barrel operation only), all long cycles will be designated as cutting down or deburring, and all short cycles as burnishing. This is done to maintain consistency throughout the tables. In the majority of cases where the work is only burnished the period seldom exceeds six hours, whereas deburring or cutting down may require anywhere up to one hundred hours. The designations are, therefore, in keeping with common practice.

In all cycles, "warm rinse," "hot rinse" and "dry" are given as the final steps. This is done on the premise that the work is completely processed and dried in the barrel finishing department and made ready for shipment to the plating or lacquering departments. In plants where the barrel finishing and plating departments are coordinated into one, the parts may be continued through the cycle without drying.

Specific comments on each table will be made in the individual caption accompanying the table.

Finish A—Highest quality finish calling for the removal of all surface imperfections by cutting down or deburring followed by burnishing to obtain a brilliant luster.

Finish B—Most economical finish consisting of bright dipping, (when necessary) followed by deburring, cutting down, or burnishing (one only). The selection of the three possibilities depends on what is considered to be most important — removal of burrs, general surface improvement, or brilliant highlights.

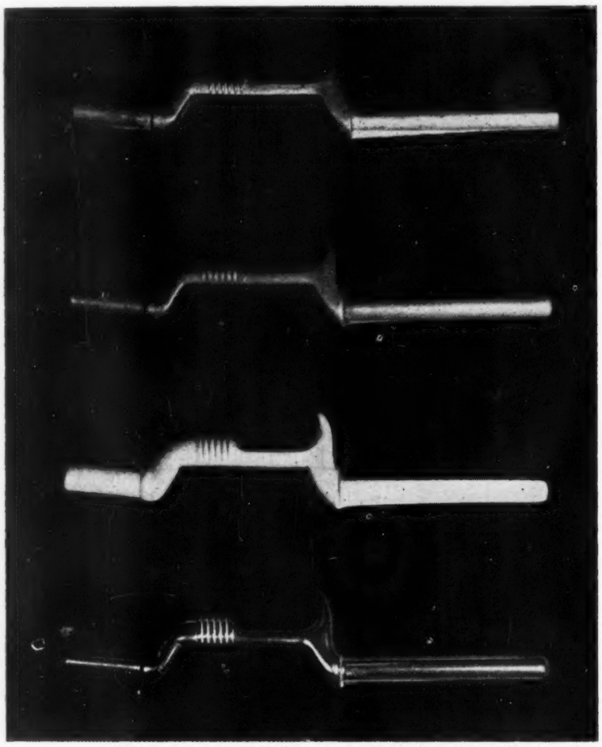
Finish C—Finish intended specifically for dimensional changes, such as the removal of sharp edges or the formation of precision radii. The appearance or color of the work is not too critical.

Finish 4—Special finishes, such as the removal of defective electroplate.

Stock Condition—Good stock condition referring only to the absence of corrosion products. The presence or absence of soils is not considered in this distinction. Poor stock condition refers only to the presence of rust, scale, or other corrosion products on the surface.

Cycle Time L—Long cycle refers to a cycle where the cutting-down step is long (4-8 hours or more). Long cycle does not refer to the number of steps in a cycle.

Cycle Time S—Short cycle refers to cycles where the cutting-down time is less than 4 to 8 hours. In such cases, bright dipping is generally better performed before any barrel finishing, rather than before the burnishing.



(Samples supplied by courtesy of American Plating Co., Des Moines, Iowa)

Figure I. These handles show four stages in barrel finishing aluminum castings: Top to bottom—As cast, As cut down, As bright dipped, As burnished. The cycle described in Table I under finish "A", stock condition "B", and cycle length "L" was employed. The cutting down time with aluminum oxide stones was 17 hours (overnight) and the burnishing time with steel shot was 2 hours.

overnight (17 hours) or longer cutting-down periods, followed by additional burnishing time. Since the brasses are mechanically tough, higher barrel speeds and lower media-to-work rations may be employed than with lighter or more fragile metals such as aluminum. Thin gauge, or fragile parts, however, must be protected from damage by high media-to-work ratios.

In the vast majority of cases, soap-base barrel finishing compounds are employed for brasses and bronzes. *The different rates of cutting are adjusted by varying the concentration of these compounds and the water level, rather than by switching compound types.* Furthermore, the degree of luster obtainable with the soap-base materials, especially on the copper alloys, is very difficult to duplicate with other non-soap base types of materials.

Nickel-Copper Alloys

The nickel-copper alloys, such as German or nickel silver, Monel, etc., are included with the copper alloys since they may be barrel finished in almost identically the same manner as brass and bronze. The only difference is the type of bright dip which is used.

Generally the nickel-copper alloys do not require bright dipping nearly as frequently as the more easily tarnished copper alloys. However, when they do, the standard nitric-sulphuric-hydrochloric acid bright dip must be employed. This solution contains the following:

Sulphuric Acid	2 gallons
Nitric Acid	1 gallon
Water	1 quart
Hydrochloric Acid	½ fl. ounce

The reader may find that a somewhat longer burnishing time may be necessary to bring the nickel-copper alloys to a satisfactory luster than the copper-zinc or copper-tin alloys. However, once the required length of time has been established, no difficulty should be encountered.

Table II—Barrel Cycles for Copper Alloys

Finish Desired	A				B				C			
Stock Condition	Good		Poor		Good		Poor		Good		Poor	
Long or Short Cy.	L	S	L	S	L	S	L	S	L	S	L	S
Clean	1	1	1	1	1	1	1	1	1	1	1	1
Rinse	2	2	2	2	2	2	2	2	2	2	2	2
Cut Down / Deburr	3	3	3	5	3		5		3	3	3	3
Rinse	4	4	4	6								
Clean			5									
Rinse			6									
Bright Dip / Pickle			7	3			3	3				
Rinse			8	4			4	4				
Burnish	5	5	9	7		3		5				
Warm Rinse	6	6	10	8	4	4	6	6	4	4	4	4
Hot Rinse	7	7	11	9	5	5	7	7	5	5	5	5
Dry	8	8	12	10	6	6	8	8	6	6	6	6

Notes—Steps 1 & 2 make up the pre-cleaning portion of the cycle and may be eliminated when the work received by the barrel finishing department is clean.

Finish "A"—As long as no tarnish need be removed, bright dipping is not necessary even in long cycles. With the elimination of the bright dip, either two or four steps may be omitted.

Finish "B"—The chemical condition of the surface determines the number of steps needed.

Finish "C"—This finish is independent of the stock condition and constitutes the lowest number of steps possible.

Refer to "General Comments and Key to All Tables" on page 67.

Ferrous Alloys

Of all the metals which may be barrel finished, ferrous alloys are the most difficult ones to process. This is true because there are so many types of steel available. These different steels furthermore have been exposed to various treatments, such as case hardening or carburizing, work hardening through drawing, heat scaling through annealing, etc. Each of these stock conditions and alloys presents the barrel finisher with an entirely different problem.

When the shape and size of the parts is suitable for barrel finishing, a desired physical surface condition can almost always be produced on steel by cutting-down followed by burnishing. The chief difficulty in barrel finishing steel is the loss of color. In some cases, the work becomes brighter for several hours, then it rapidly becomes duller and darker. There are three theories to explain this effect, none of which the experts can agree upon. These three are:

1. A slow but constant oxidation of the surface.
2. The impregnation of the surface by the broken-down media in much the same manner as the softer metals.
3. A continual increase in the number of minute scratches which occur at the same time that the larger imperfections are removed; these scratches persist due to the hardness of the steel, until a dark appearance is imparted to the work.

It is quite possible, of course, that a combination of these factors, as well as several others, may cause this effect. The foregoing should not give the reader the impression that all steels always darken. This difficulty

with discoloration manifests itself only in 5-15% of the cases encountered.

For most operations, the soap-base or alkaline finishing compounds will serve very satisfactorily. For rapid cutting or economical finishing the alkaline compounds are generally better suited. For higher quality finishes the soap-base materials should be employed.

There are several means of overcoming the discoloration. One of the most effective means is to change the pH of the solution in the barrel. Very often, one type of steel will lose its color at a low pH and become bright again at a high one. At other times just the reverse holds true. It is, therefore, a matter of experimenting until the best type of barrel finishing compound (alkaline or soap-base) has been determined for a particular type of steel.

Frequent changes of solution to prevent an excessive amount of broken-down media is also a good precaution when barrel finishing steel over long periods.

Some operators prefer the use of an acidic finishing compound, or an acid pickle, after the cutting-down operation and before the burnishing to improve the color. When an acidic barrel finishing compound is used, speed must be employed to bring the steel back to an alkaline condition as soon as the acid compound is drained from the barrel. This is to prevent the steel from rusting. It is well known that steel is much more prone to rusting when it is in an acidic condition.

Recently, work has been done on both an experimental and on a production basis employing zinc balls and shapes as the media. Emery powder or an abrasive barrel finishing compound is used to provide the cutting, while the zinc serves to carry the abrasive and separate the work. The cutting action under these conditions is slower than when aluminum oxide stones are employed. However, the color of the steel in almost every case is better. Generally, a non-soap-base barrel finishing compound is employed for this operation although some work is being done using soluble oil emulsions. A great deal of promise is shown by this method both in the laboratory tests and under actual full scale production conditions. (This zinc media is also employed with great success in the finishing of zinc die-castings.)

Removal of Rust and Heat Treat Scale

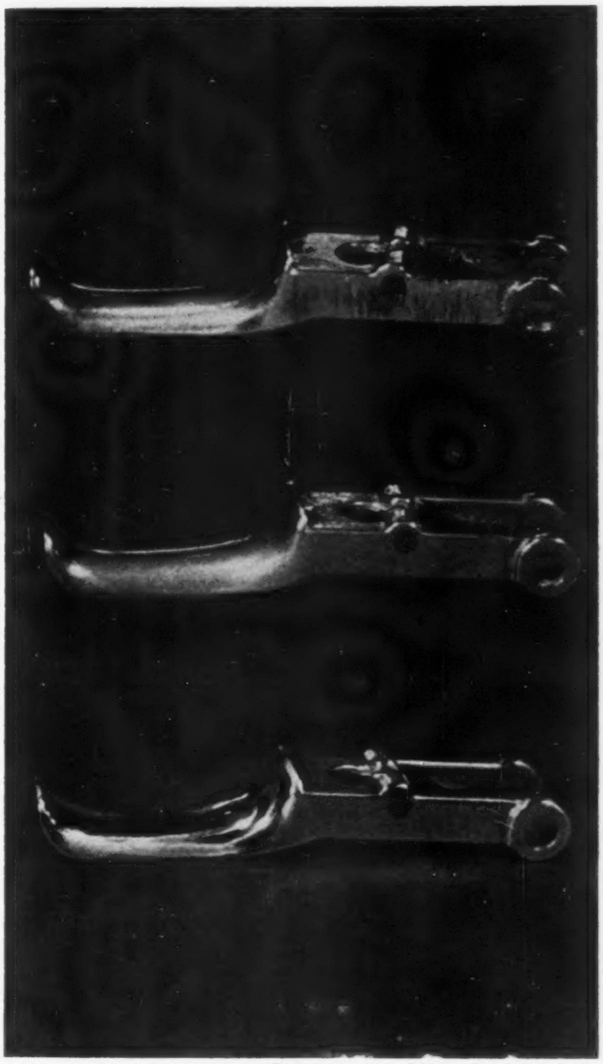
Steel is often received by the barrel finishing department covered with cutting oils, slushing oils and rust preventatives, as well as either rust or heat scale. Once the oils have been removed by alkaline cleaning, the rust and scale may be removed by one of three methods:

1. Mechanically cutting the corrosion products from the work with the media and simultaneously finishing the surface. An alkaline or soap-base compound is used in this operation. On very heavy scale a low water level is employed in the beginning with the possible addition of a powdered abrasive material. The water level is raised for the final finishing after the scale has been removed.
2. Acid pickling the work before placing it into the barrel and then finishing the surface with the alkaline or soap-base compounds. This pickling follows the alkaline pre-cleaning before any barrel finishing is begun.
3. Employing an acidic barrel finishing compound to remove the scale and rust and then changing to an alkaline or soap-base compound to obtain the desired finish.

It should be noted that the treatment of steel differs from non-ferrous metals in that the pickling precedes the barrel finishing operation, or is the first operation, instead of coming between the cutting-down and burnishing.

Acidic Barrel Finishing Compounds

The acidic barrel finishing compounds are seldom employed in long cycles. Their solutions are put into the barrel for from five to thirty minutes and then either returned to a holding tank or discarded. As soon as the acidic material has been drained and the barrel rinsed out, the alkaline material should be introduced. Some operators prefer to introduce a strongly alkaline soap-free material into the barrel while the acidic com-



(Photo courtesy Oakite Products, Inc.)

Figure 11. These triggers show three stages in barrel finishing brass parts. Top to bottom—As cast and rough ground (note scratches on flats), As cut down, As burnished. The cycle described in Table II under finish "A", stock condition "G", cycle length "S", was employed. The cutting down time in aluminum oxide stones was 7 hours and the burnishing time with steel shot was 1½ hours.

pound is still in the barrel. This serves to neutralize the work without ever exposing it to the action of air while it is in an acidic condition.

The acidic material will attack the steel slightly, thereby releasing hydrogen and generating pressure in a closed barrel. Caution must therefore be employed to properly vent the barrel (if it is a closed type). When this is not possible, the seal must be cracked slowly at first to release the pressure. Open flames and sparks in the vicinity of the barrel should be avoided due to the explosive properties of hydrogen. Some installations employ open tilting barrels for the acidic operation and then transfer the work to closed horizontal barrels for the remainder of the cycle, thus avoiding any difficulty with pressure build-up.

The acidic materials should never be used when case hardened, polished steel shot is in the barrel. The polished surface will be slightly etched by the acidic materials and require re-polishing. After several such operations the hardened case will have been removed.

In the majority of cases it is easier to clean and pickle the work in baskets and tanks prior to barrel finishing. For this purpose, an inhibited acidic material is frequently better suited than a raw acid. There is also much less smut developed with this latter type of material.

When the part is so shaped that the media will contact all areas, there frequently is no need of pickling the work. All rust and scale may be cut off in a few minutes by the use of abrasive stones or added abrasive powder in the barrel.

Table III—Barrel Cycles for Ferrous Alloys

Finish Desired	A				B				C			
Stock Condition	Good		Poor		Good		Poor		Good		Poor	
Long or Short Cy.	L	S	L	S	L	S	L	S	L	S	L	S
Clean	1	1	1	1	1	1	1	1	1	1	1	1
Rinse	2	2	2	2	2	2	2	2	2	2	2	2
Cut Down / Deburr	3	3	5	5	3		5		3	3	5	5
Rinse	4	4	6	6								
Clean												
Rinse												
Bright Dip / Pickle			3	3			3	3			3	3
Rinse			4	4			4	4			4	4
Burnish	5	5	7	7		3		5				
Warm Rinse	6	6	8	8	4	4	6	6	4	4	6	6
Hot Rinse	7	7	9	9	5	5	7	7	5	5	7	7
Dry	8	8	10	10	6	6	8	8	6	6	8	8

Notes—Steel is frequently covered with drawing and stamping compounds, slushing oils, rust preventatives, etc. Steps 1 & 2 make up the pre-cleaning portion of the cycle and may be eliminated when the stock is received in a clean condition.

Finishes "A" & "B"—When the stock is in a poor condition, it is pickled before any barrel finishing is done. This eliminates the two additional cleaning steps which bright dipping during the cycle call for.

Finish "C"—This finish is comprised of the minimum number of steps necessary, and differs from the other "C" finishes in that corroded work must be pickled if the media can not cut the corrosion products off.

Refer to "General Comments and Key to All Tables" on page 67.

Zinc Alloys

The use of zinc die-castings has been on a rapid upswing in the last few years. Because of their intricate shapes, die castings are often more easily and uniformly processed in a barrel than on a wheel. Furthermore, the parts are frequently small and therefore hard to apply to a wheel.

A very high percentage of die-castings are plated. Generally, die-castings are processed for two reasons: to remove flash, and to produce a smooth uniform surface and a high luster as a base for subsequent plating. From the mechanical viewpoint, zinc is an ideal metal for barrel finishing techniques. Chemically, however, great care must be taken not to attack the zinc and not to form any undesirable or insoluble films. When in contact with soap-containing materials, zinc is very prone to the formation of insoluble zinc soaps. Unless a very short run of ten to fifteen minutes is used, it is usually better to employ a non-soap base alkaline barrel finishing compound. This alkaline material must not attack the zinc severely, but it is advantageous if the zinc is *slightly* soluble in the solution. This serves to produce and keep a "clean" surface on the zinc parts.

It is imperative that when the barrel finishing cycle has been completed, the parts be rinsed, separated and dried *immediately*. The fresh, bright surface of the zinc is very sensitive to corrosion. This tendency is increased by leaving the parts wet, especially when in contact with another metal (i.e. steel burnishing media).

Die-castings may be cut down with aluminum oxide stones, but experience has shown that the use of metallic zinc "burnishing"* media often is better for cutting down zinc castings. Zinc die-castings being rather soft are very apt to have the broken-down media imbedded into their surface, thereby darkening their color. By using zinc media, this possibility is avoided. Naturally the cutting rate is slower than with stones. From time to time, it is helpful to re-roughen the zinc media by rolling it for twenty ot thirty minutes with 60-80 mesh emery powder. For the final finishing, steel shot is employed.

For the light cutting operations, the zinc media may be employed without any additional abrasive powder. However, for the removal of large quantities of metal, some 120-120 mesh emery powder should be added to the charge to speed the rate of cutting.

Zinc may be bright dipped, providing suitable alloys are encountered. This is generally not a recommended practice, although knowledge of its existence is helpful in emergencies. The bright dip used contains 10 oz./gal. of chromic acid and 1 oz./gal. of sulphuric acid. As a rule, there should be no need for bright dipping castings, since almost all barrel finishing is done on new parts. When the color has been lost, however, bright dipping is almost the only way of regaining it. The dense surface skin on the castings is not thick enough to permit the entire surface to be mechanically ground away on non-uniformly shaped parts. If the work processed were round balls, the mechanical method might work, since the action could be stopped immediately when the discolored surface has been removed. When the shape is irregular, however, the skin will be cut through at high points before the discolora-

**The use of the term "burnishing" here is not in keeping with the writer's definitions as given in Installment I, but rather the name under which this media is sold.*

tion has been removed from the plane or recessed surfaces.

Copper Plating Before Burnishing

A good method sometimes employed in the finishing of zinc prior to bright electro-plating is to perform the necessary cutting-down operation on the die casting with either aluminum oxide stones or zinc media and then heavy copper plating the parts. This copper coating is then burnished with steel shot to a high luster, prior to bright nickel and chrome plating. This is not applicable in all cases, but should be given some consideration when a new operation is planned. It is especially well suited for work which is barrel plated. Since there is no racking or unracking to increase the labor cost excessively, the benefit of placing the work into the bright nickel bath in the best possible surface condition may be fully exploited.

Table IV—Barrel Cycles for Zinc Alloys

Finish Desired	A				B				C			
Stock Condition	Good		Poor		Good		Poor		Good		Poor	
Long or Short Cy.	L	S	L	S	L	S	L	S	L	S	L	S
Clean				1				1				
Rinse				2				2				
Cut Down / Deburr	1	1		5	1				1			
Rinse	2	2		6								
Clean												
Rinse												
Bright Dip / Pickle				3				3				
Rinse				4				4				
Burnish	3	3		7		1		5		1		
Warm Rinse	4	4		8	2	2		6	2	2		
Hot Rinse	5	5		9	3	3		7	3	3		
Dry	6	6		10	4	4		8	4	4		

Notes—Almost all the zinc which is barrel finished is in the form of new die-castings. Unless these have been machined with some type of non-water-soluble oil, pre-cleaning will not be necessary. The cycles in the table, therefore, do not include any precleaning steps.

Generally, bright dipping of zinc is not recommended in barrel finishing. Therefore the bright dipping is only included in two places in the above table to indicate where the bright dipping should be introduced.

Finishes "A" & "B"—The long cycles under *poor stock* have been omitted, since any poor stock which is processed is most probably reconditioning work. Any long cutting down on such items would change the dimensions beyond use. Furthermore, any flash or parting lines would have been removed during the original processing.

Finish "C"—Since poor stock condition would only be encountered in reprocessing, and since dimensional changes must be accurate, both the long and short cycles under poor stock condition have been omitted for finish "C".

Refer to "General Comments and Key to All Tables" on page 67.

Electroplated Metals

The fact that no metal is removed by burnishing is the greatest advantage of this technique when employed on electro-deposited metals. This makes it possible to burnish even very thin layers of soft metals without cutting through to the base metal. Burnishing of plated deposits is generally done on the softer plated metals such as silver, copper, brass, cadmium and zinc.

Plated articles are barrel processed for three principle reasons: to produce a desired luster or polish on the plated surface, to work harden the plated coating, thus increasing its abrasion resistance, and to remove faulty plating. For finishing and work hardening purposes, the plated articles are always burnished and never cut down. Cutting down is obviously impractical due to the hazard of cutting through the plate at high points.

Barrel Finishing vs. Plate Adhesion

As the reader knows, rolling the part in a finishing barrel is one of the rigorous tests for deposit adhesion. Therefore, if there is a possibility that the adhesion on a particular item is not too good, barrel finishing should be avoided. Such a case might be where a non-conducting material has been metallized prior to the plating. During burnishing, the bond between the base material and the lacquer may be weakened or broken, resulting in blistering.

Silver Plate and Silverware

Silver plate represents a very large portion of the barrel finishing work done on plated items. Barrel plated items, and even some of those plated on racks, may be brought to a very brilliant finish in a few minutes by burnishing them with steel shot employing a soap-base compound. For those platers who prefer to operate a dull silver solution without brighteners, this is an ideal method for obtaining a high luster on small parts with a minimum of effort.

Many small plants and job shops equipped with burnishing barrels and steel shot regularly burnish silver plated tableware for restaurants. On a steady contract basis this can amount to a considerable quantity of work. Very short cycles ranging from ten to forty-five minutes are employed for this type of work. No attempt is made to remove nicks and deep scratches. However, when seen for the first time, the change brought about is truly remarkable. The abrasion resistance has also been increased by the burnishing. A thorough alkaline cleaning and, when tarnished, electrolytic detarnishing on an aluminum plate or a short cyanide dip should preceed the burnishing.

Copper Plated Zinc

The burnishing of copper that has been plated over zinc die-castings or steel parts is an operation that is becoming more popular. At times, better results are obtained or less total time is required when the zinc or steel parts are cut down in the barrel and copper deposited on the "as-cut" surface. This copper may then be burnished to the necessary brilliance. (This is an operation parallel to the one in wheel or belt finishing where the copper plate rather than the base steel is buffed.) This intermediate burnishing is actually much more easily done than the intermediate buffing. When work has been buffed, the buffing compounds must be removed during the cleaning cycle. This is a much more difficult matter than removing the small quantity of soap film left on the work by the burnishing.

Since pure copper, such as is plated out on the work, is soft, it may be very rapidly burnished. Due to its lower chemical activity, not nearly as many precautions must be employed to keep copper from spotting.

Brass plating the zinc or steel parts instead of copper plating may also be employed. The brass coating may be burnished in the same manner as the copper.

Cadmium and Zinc Plate

Electrodeposited coatings of cadmium and zinc may be barrel finished to obtain a more lustrous surface. The main advantage stated for burnishing these metal coatings is not so much for the appearance as to improve their corrosion protection by closing up surface porosity.

Removal of Defective Plate

Abrasive barrel finishing techniques may be very effectively employed to remove defective plating, providing that the work is so shaped that the media can reach all of its surfaces. For this type of operation it has been found best to use either new aluminum oxide stones with compound only, or fairly smooth ones with the addition of emery powder or an abrasive barrel finishing compound. The length of the cycle depends on the thickness and type of plate as well as the shape of the work. That type of barrel finishing compound which is best suited to the base metal is employed when removing defective plating. A minimum of these non-abrasive types of barrel finishing compounds are employed for this operation to hold the lubrication to a low degree.

Once the plating has been removed, the abrasive should be flushed from the barrel and the concentration of the finishing compound and the water level adjusted to finishing conditions. The work may then be re-finished and re-plated.

If precision tolerances are to be maintained, this operation may not be feasible, since the plate will not be removed from all areas at the same rate. The cutting action will continue on the base metal once the plate has been removed from a particular area. On very regular shapes, of course, the operation can be stopped immediately after the deposit has been removed and the precision tolerances maintained.

Table V—Barrel Cycles for Plated Metals

Finish Desired	B				D			
Stock Condition	Good		Poor		Good		Poor	
Long or Short Cy.	L	S	L	S	L	S	L	S
Clean				1				
Rinse				2				
Cut Down/Deburr					1			
Rinse					2			
Clean								
Rinse								
Bright Dip/Pickle				3				
Rinse				4				
Burnish		1		5	3			
Warm Rinse		2		6	4			
Hot Rinse		3		7	5			
Dry		4		8	6			

Notes—Finish "A"—This type of finish has been omitted since cutting down is not practical on plated coatings.

Finish "B"—Generally only short burnishing cycles are employed on plated metals.

That cycle under poor condition, short cycle, is for such operations as re-processing or re-conditioning work. Tableware would come under this heading.

Finish "D"—This cycle is for the removal of defective electrodeposits and burnishing prior to re-plating.

Refer to "General Comments and Key to All Tables" on page 67.

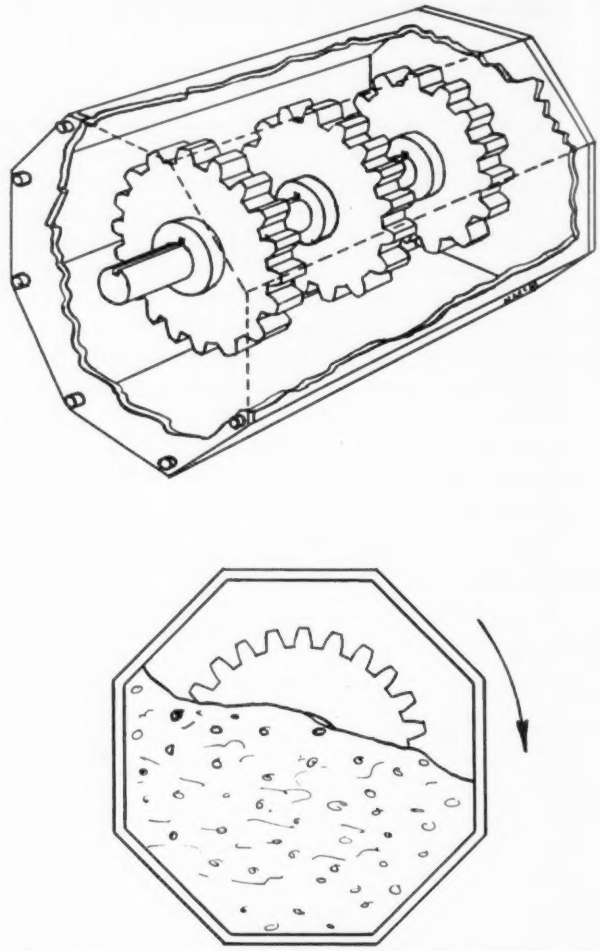


Figure III. Gears were among the first items to be processed with the technique of racking in a finishing barrel. This serves to do the "breaking in" which frequently necessitate hand filing. Large gears may be held on a central spindle as shown in the drawing. Smaller parts are held on other types of racks. The barrel shown in this drawing must be loaded and unloaded from one end and the direction of rolling should be reversed for half the total time to provide even wear on both sides of the gears.

Lead and Lead Alloys

The total quantity of lead which is barrel finished is not very great. Most of this is done in the costume jewelry industry which finds lead very convenient for its centrifical casting processes.

These lead and lead alloy castings are frequently barrel finished before plating. The type of cycles generally employed range from light cutting to burnishing. Since these castings consist mainly of intricate items which will not stand much cutting, burnishing is the barrel finishing operation most often performed. Furthermore, since lead is a very soft metal and may be easily deformed in a barrel, very low barrel speeds and high ratios of media-to-work must be maintained.

Lead is processed in the same manner as the other soft metals, with the exception that greater care must be taken due to the insoluability of so many of its compounds. Like zinc, lead may form insoluble metallic soaps when in contact with soap-base barrel finishing compounds. Therefore, the use of an alkaline type compound is generally recommended. Lead will, furthermore, form insoluble lead sulphate if the barrel finishing compound or an acid pickle contains any sulphuric acid or sulphate salts. This film, although

very thin, may be rolled into the surface and interfere with the subsequent plating.

The use of fluoboric acid as a pickle either before the barrel finishing and especially just before plating is strongly recommended.

When these few precautions are attended to, lead becomes a very satisfactory metal for barrel finishing techniques.

Noble Metals

The noble metals silver and gold have long been barrel finished and are ideally suited for this type of operation. They are soft and malleable so that very smooth and bright surfaces may be produced with steel balls.

For economic reasons, the noble metals are seldom cut down in a barrel. This is especially true of gold. Since the cutting action in a barrel cannot be restricted to a definite area, the overall metal loss may become too great. This same situation is true with silver. As the price of silver is lower than gold, however, more of it may be lost without serious consequences, providing the labor saving is sufficiently large. Small parts such as sterling identification bracelets and particularly the silver-soldered links in the bracelet's chain, lend themselves very well to barrel cutting and burnishing.

Steel burnishing balls and shapes are the most commonly used media for work on the noble metals. A very high luster may be produced in anywhere from ten minutes to several hours depending on the original condition of the work. Under very unusual circumstances, a very soft abrasive material such as bentonite may be added to the steel shot in the form of a slurry. This material is not hard enough to scratch the shot, but will act on soft metals such as silver or gold.

Most silver and gold work is used for decorative purposes and therefore requires a very high quality finish. On small parts, when the surfaces are highly curved, any irregularities will be so optically distorted that they are not noticeable. On straight plane surfaces, however, this effect does not manifest itself. To take full advantage of barrel techniques on the noble metals, they may first be barrel cut and/or burnished to produce the desired surface and luster on the round and difficult-to-reach areas, and then color buffed on the flat areas for final finishing.

The industries working with noble metals have the advantage that the cost of time and other materials (aside from labor, of course) does not play as large a role as for someone in the novelty business who is making, for example, a give-away item such as beer can openers. If need be, the barrel finishing compound may be changed more often and used at a higher concentration to take full advantage of every bit of its lubricating ability. Furthermore, barrel speeds may be made slower to further eliminate peening by the work contacting itself, and the media-to-work ratio may be made larger.

Conclusions

In these articles, it has been the writer's purpose to point out some of the basic factors involved in barrel finishing that had not already been thoroughly treated elsewhere. These articles were approached from the viewpoint of obtaining the maximum flexibility from these techniques.

Table VI
Barrel Cycles for Soft and Noble Metals

Finish Desired	A				B			
Stock Condition	Good		Poor		Good		Poor	
Long or Short Cy.	L	S	L	S	L	S	L	S
Clean				1			1	1
Rinse				2			2	2
Cut Down/Deburr		1		5	1		5	
Rinse		2		6				
Clean								
Rinse								
Bright Dip/Pickle				3				3
Rinse				4				4
Burnish		3		7		1		5
Warm Rinse		4		8	2	2	6	6
Hot Rinse		5		9	3	3	7	7
Dry		6		10	4	4	8	8

Notes—Finish "A"—The long cycle under good stock condition is omitted, since "heavy" cutting-down is seldom employed on these metals.

Poor stock condition on the noble metals may be due to silver soldering scale. This is pickled off before barrel finishing is begun.

Finish "B"—The long cycles under finish "B" are given since they are occasionally employed to cut down silver electrical parts. Again, soldering would account for poor condition. Decorative items which are to be subsequently buffed also come under finish "B".

Refer to "General Comments and Key to All Tables" on page 67.

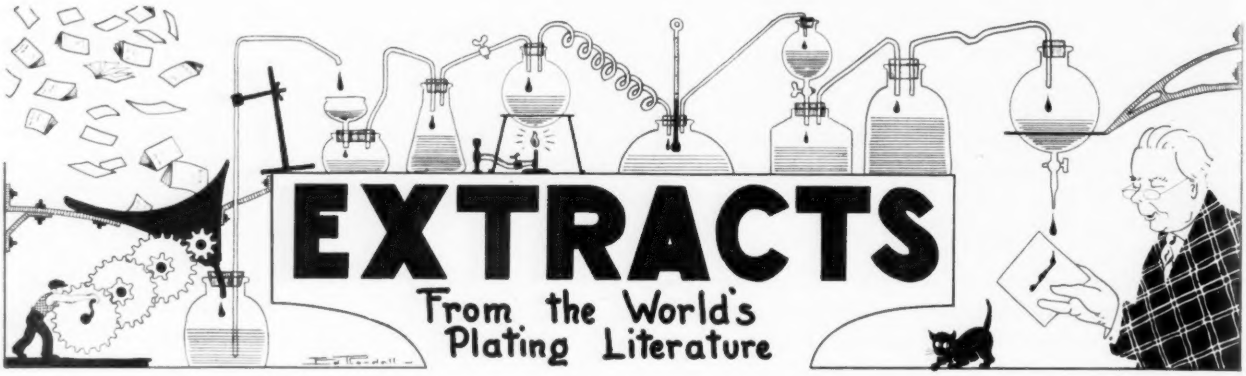
Since all of these factors are variables, some experimentation must be done to find the best possible cycle for a particular production part. This experimental work may be done either in the plant or samples may be sent to suppliers of barrel finishing compounds, suppliers of barrels, or suppliers of media, many of whom maintain customer service laboratories available to the industry at no charge. These companies will process the samples and determine the proper conditions for barrel finishing, such as media-to-parts ratio, size and condition of media, type of compound, barrel speed, water level, number of media changes, bright dips and pre-cleaning. In many cases, they will recommend necessary steps for subsequent operations such as plating or lacquering. These recommendations will save the manufacturer manys days or weeks of experimenting and occasionally show him results that he never suspected were possible with barrel techniques.

The cycles as recommended still require a slight amount of alteration to compensate for local conditions. These modifications are generally a matter of varying the length of one or more of the rolling periods. It must be realized by the barrel finishing supervisor that the suppliers' recommendations give him a working basis on which to plan his barrel finishing and are not a fool-proof "cook-book" recipe. He should be aware of the factors involved in barrel finishing and on this basis alter the recommendations of the laboratories to suit his individual needs.

Future Developments

Barrel finishing techniques have changed very radically in the last few decades. Where once it was either

(Concluded on page 76)



Plating on Aluminum — Surface Preparation, and Plating Baths

Galvano (Paris), vol. 20, No. 171, pp. 13-16.

Baths of various composition are used for pickling the aluminum, the composition depending upon the nature of the alloy being handled. Pickling with chromic acid is done in the following bath:

Chromic acid	42 grms./litre
Sulphuric Acid conc.	210 grms./litre.

The bath works at 65° C. and the duration of immersion varies from 1 to 5 minutes. Where aluminum-magnesium-silicon alloys are being treated .05% by vol. of hydrofluoric acid is added to the bath. The chromic acid pickle gives a light attack on the metal surface which improves the adherence at the zincing and plating stages.

A caustic soda pickle is given with a 5% solution at a temperature of 65° C. The parts remain in the bath for 5 seconds.

A nitro-hydrofluoric acid bath is used for forged aluminum alloys and is made up of 1 vol. of 48% hydrofluoric acid and 3 vols. of nitric acid. This bath works at ordinary temperature with a 30 second dip.

At the zincing stage, the operations are common to both cast and wrought alloys. The excellent adherence of the zinc deposit before the plating is attributed to the following factors:

a) Production of a light film of oxide
b) Production of a finely eroded surface capable of giving good anchorage.
c) Solution of all the surface impurities.

The solution zincate bath consists of zinc oxide 120 grms./litre and caustic soda 640 grms./litre. The bath temperature is 27° C. and a 2-5 minute immersion is given. To achieve the zincing of aluminum alloys containing copper the bath concentration should be reduced by 25%. The bath solution is viscous and entrainment losses need making up by additions. A very thorough rinsing is necessary after the zincing stage to avoid fouling the plating baths.

For anodic treatment for plating, two methods are available to obtain an improved anodic film capable of affording support to a normal electroplated deposit. The first method used consists of obtaining an oxide film by anodic treatment and then subsequently modifying this film by utilizing an appropriate solvent.

The second method aims at the production of an adequate anodic film by the employment of suitable operating conditions. The solution of the anodic film in the first method can be achieved either by cathodic reduction in the same bath as the electroplating or else by simple treatment in a solution of sodium cyanide or hydrofluoric acid. This procedure then embodies the following stages:

1. Anodic treatment at 60 volts.
2. Reduction of the oxide and simultaneous formation of a film of brass at 5 volts.
3. Nickel or cadmium plating on the brass by normal electroplating methods.

Careful cleaning is necessary before the anodizing stage. A trichlorethylene cleaning is given and then a rinse with an alkaline solution as neutral as possible as regards the metal (for example a 4% solution of sodium cyanide). The anodic treatment is conducted in an oxalic acid bath (3%) at normal temperature. The bath should not be allowed to become heated to higher than 30° C. and if a large number of pieces are passing through the bath, artificial cooling may be necessary. The anodizing current density is 0.54 amps./sq. dm. Initially 11 volts is used, but immediately the anodic film has commenced to form this is rapidly increased to 50 volts for a total period of 10 minutes. A very careful rinsing in cold water is then given.

The structure of the anodic film is then modified in a bath consisting of 6% by weight of sodium cyanide or 0.25% by volume of hydrofluoric acid. The hydrofluoric acid content is critical and frequent bath analyses should be made. The duration of the treatment may reach 15 minutes for pure aluminum and be as low as 5 seconds for an aluminum-copper alloy. The duration of the treatment is critical and should be controlled. The object is to achieve a porosity, and the greater the effect achieved the more uniform will be the subsequent plated deposit. The parts are then rinsed and passed wet into the plating bath. The surface thus prepared is suitable for the direct application of brass, nickel, cadmium and silver. Normal bath solutions can be used with the exception of high pH or too high a bath temperature. In the case of a strongly alkaline bath, an intermediate plate must be made in an acid bath to avoid solution of the anodic film.

To plate directly on a sufficiently porous anodic

film, the anodic treatment is conducted in a bath containing 3% by volume of phosphoric acid, operating at a temperature between 40° and 50° C. at 90 to 100 volts. The treatment duration is 5 minutes. A part of the oxide film formed is subsequently dissolved away by the alkalinity of the plating bath.

Pickling of Copper and Copper Alloys by Ferric Sulphate

J. Bary: *Galvano* (Paris), vol. 19, No. 158, pp. 9 to 10.

The pickling of copper, brass and copper alloys by ferric sulphate, based on surface deoxidation by the ferric sulphate solution, takes place according to the following reactions:

$$3\ Cu_2O + 4\ Fe_2(SO_4)_3 \rightarrow 6\ CuSO_4 + 6\ FeSO_4 + Fe_2O_3$$
$$3\ CuO + Fe_2(SO_4)_3 \rightarrow 3\ CuSO_4 + Fe_2O_3$$

Hydrolysis of the solution gives a certain percentage of free acid which plays a part in the reaction.

When the pickling effect is compared of baths normally composed of sulfuric acid and the pickling effect given by solutions of ferric sulphate at analagous concentrations and the same temperature, facts which are immediately apparent are:

1. At normal temperature (15°-25° C.) the sulfuric acid pickling is extremely slow, while the pickling effect of baths composed of ferric sulfate is much more rapid.
2. At a temperature between 40°-50° C. a 10% sulfuric acid pickle on ordinary 70/30 brass gives a loss of weight of 228 grms./sq. metre/hour while, with the same concentration in SO_3, a ferric sulfate pickle gives a loss in weight of 500 grms./sq. metre/hour.
3. To obtain pickled surfaces which show the same processed effect from the two baths, it is necessary to allow 3 to 5 times as long in the sulfuric acid bath; in addition the appearance of a ferric sulphate solution pickled part always shows a more uniform and less tarnished appearance.

Cupro-nickel alloys can be well pickled in solutions of ferric sulfate, lightly sulfuric. To obtain the most brilliant and white appearance it is necessary to avoid exceeding 3% of free sulfuric acid for a 10% concentration of ferric sulfate. The optimum temperature is between 50° and 60°C. Solutions of chromic acid and of ferric sulfate, with 5% of CrO_3 for 10% of ferric sulfate, gives a bright dip bath, which while it cannot give a brass a "white" appearance, such as is given by the sulfuric-nitric acid bright dip, gives the brass a gilded aspect which is very pleasing and does not tarnish easily.

Copper Impurity Build-Up in Nickel Plating Baths

Galvano (Paris), vol. 19, No. 159, pp. 9-10.

Discussing one of the serious causes of impurity build-up in the plating bath as originating from the gradual accumulation of trace impurities in the plating salts a questionnaire revealed that this trouble is more widespread than is commonly realized.

Analysis of three samples of nickel sulfate from different suppliers showed a copper impurity varying between 0.5 to 0.7 grams per kilo of salt (2.2 lbs.). Thus, with a 250 grms./litre nickel sulfate bath, with the new bath freshly prepared, there is an impurity of 0.15 grms./litre of copper metal, which is much more than is necessary to give a dark or striated deposit. The following table shows the influence of the concentration of copper in nickel bath of the following composition:

Single nickel sulfate	140 grms./litre
Ammonium chloride	14 grms./litre
Boric acid	16 grms./litre

Copper Concentrate grms./litre	*Bath pH*	*Appearance of Deposit*
0.007	5.18 to 5.85	Satisfactory deposit.
0.035	5.15 to 5.75	Satisfactory deposit. No visible effect on copper.
0.070	5.18 to 5.8	Some dark stria on lower corners of deposit.
0.140	3.65 to 6.7	Brittle deposit with spongy zones at bottom.
0.700	5.10 to 6.45	Brittle and spongy deposit.

This indicates that the maximum allowable tolerance for copper in the nickel bath is 0.03 grms. per litre, and this maximum should be lowered to 0.02 for thick deposits. Careful control of the purity of the nickel salt purchased is stressed.

Tin and Lead Anodes

E. R. Thews: *Metalloberflaeche*, vol. 4, No. 12, pp. B. 187-B. 188.

Tin anodes for electroplating should have a maximum of 0.015% iron. As regards other impurities, these are not covered by the German Standards for the metals copper, lead, antimony, etc. The smallest possible amounts of lead, antimony, and arsenic should be present and lead should be regarded as the most troublesome impurity. The presence of lead and (in greater amounts) of antimony and arsenic in alkaline tin baths gives dark and spongy deposits. Both with alkaline and acid tin baths, the smallest possible lead content should be required in the anodes and bath. The lead will be deposited with the tin and for food containers and domestic utensils, the presence of this lead will be a distinct danger to health.

A great deal of conflicting details have been given in the technical press regarding the influence of the tin anode impurities on the characteristics of the tin plate from alkaline and acid baths, but particularly the latter. Some of the facts contradict others that have been given from different sources. This may be ascribed to the fact that some faults ascribed to the anodes have been due to the formation of stannite in the bath; however, this could be directly caused by impurities in the anode as a secondary result.

Lead anodes are almost always used in lead plating in the form of rolled, refined lead plate and strips, the upper edge being bent over and providing the anode suspension.

For most electroplating lead processes, it is not necessary to use an electrolytically refined lead for

the anodes; first grade refined lead with a content of 99.95-99.96% is quite satisfactory for use. A small amount of antimony will not be harmful, as this is not cathodically deposited but ends up as anode slime. However only a slight trace of antimony should be tolerated; higher contents are not recommended. In some technical quarters antimonial lead anodes have been recommended for use containing 5-6% of antimony. There is no technical justification for the use of this composition anode material in place of pure soft lead, and the technical advantages claimed for antimonial lead anodes may be regarded as purely imaginary.

Soft lead anodes are easily soluble both with high and low current densities and give in acid electrolytes uniformily good metal ion concentration. Anode and cathode efficiencies amount in these electrolytes to 100%. Alkaline lead electrolyte baths, which are not so commonly used, do not show such favorable characteristics. The anode efficiency in these baths is not nearly so high as the cathode efficiencies (only about 30-50%) so that lead salts must be added to the bath to maintain the optimum metal ion concentration.

In the normal lead acid bath electrolytes, the anode surface should be maintained at least as great as cathode surface, and most often greater anode surfaces are preferred. The optimum region is fairly broad, but in the interest of the cathodic current density not too broad an interval should be maintained. If too great an anode surface is maintained in relation to the cathode surface, then on account of the too-high cathodic current densities, a more or less coarsely crystalline lead deposit will be obtained.

As the throwing power of acid lead baths is relatively bad, although this can be improved within limits with increasing acid content and decreasing metal ion concentration as well as by addition colloids, most frequently it is necessary to work with well profiled lead anodes, generally with suitably arranged auxiliary anodes in order to obtain a uniform lead deposit.

Faulty Insulation with Plating Equipment and Faults Arising Therefrom

G. Schuster: *Metalloberflaeche*, vol. 5, No. 6, p. B. 87.

Mention is first made of chromium plating baths. Stray electrical currents here, caused by faulty tank insulation, leads not only to corrosion of the steel tank, but this in turn causes the iron content of the bath solution to rise rapidly, necessitating frequent adjustment. In Germany many chromium platers have had the experience of having the inner walls of their chromium plating tanks corroded through within 2-3 years at the corners and around the top level of the solution. The cause of this is carelessness and the remedy is quite simple — to pay careful attention to bottom and all round electrical insulation of the bath. It is recommended to stand steel plating tanks on steatite blocks which are preferable to cement floors or wooden support blocks, which are always wet.

Plating faults which are quite often ascribed to the bath solutions or to the plating salts can be traced back to faulty electrical insulation. Electrical leakage can lead to part of the plating, anodizing or degreasing current branching to other coupled tanks. Steel or lead lined tanks should always be provided with loose glass lining plates between the anodes and the tank walls. Electrical leakage among other things can result in all or part of the plating current passing to the tank walls instead of to the cathodes. Without this glass lining, the lead lining or even the bath heating coil quite often has been found to act as the cathode and more frequently still and what is worse, as the anode. The latter case leads to destroyed lead linings and ultimate tank failure, to bath foaming and to rough deposits in the neighborhood of the lead. The bath solution becomes rapidly contaminated with lead and quickly unusable.

Badly electrically insulated heating coils can result in the plating baths coming into electrical circuit with the entire heat circulating system, the water and gas supply pipes and even the steel framework of the building structure. Another bad feature of faulty electrical insulation of this type is that stray a.c. current from neighboring electrical machinery such as electric motors, condensers, etc. can migrate into the plating bath and exercise bath disturbances. All gas and water and solution pipes leading to the tank should be broken with an electrical insulating coupling.

PRACTICAL BARREL FINISHING

(*Concluded from page* 73)

a matter of tumbling castings or ball burnishing, it has now become a complete metal finishing process capable of producing both size and surface modifications as required. Despite this progress, the limitations of barrel finishing have not been approached.

There is much development work to be done in this line. Systems such as racking the work in a barrel, for instance, have been little used to date but show great possibilities for processing large items (see Fig. III). The use of masking or stop-off lacquers to protect certain areas of the work is also being experimented with, but much more work is needed before it may be adopted as a standard practice.

Barrel designs (a large topic which has not been covered in this paper) are constantly modified with different concepts incorporated into the new models. Larger barrels and better auxiliary equipment for handling the loads are reducing both the length of the rolling period and the transfer times. New types of media and better barrel finishing compounds are constantly being developed to further aid the metal finishing industry.

Barrel finishing is a field that will take a larger and larger position in the metal finishing industry. In the near future, these techniques will be combined with electro and chemical polishing, periodic reverse and other bright plating on an increasingly larger scale to provide the industry with constantly better finishes at lower costs.

Acknowledgments

The writer wishes to acknowledge his appreciation to *Mr. G. A. Lux* and *Mr. Martin F. Maher, Jr.* for their many helpful suggestions during the preparation of this article.

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Re-Claiming Cadmium from Rinses

Question: How can we re-claim the cadmium plating chemicals from the rinse waters? We would prefer to recover the chemicals in solid form if possible.

S. G.

Answer: Assuming that the rinse water contains only cadmium salts, the metal can be recovered by making the water alkaline with caustic soda, which will precipitate the cadmium as a white cadmium hydroxide. This should then be allowed to settle, the supernatant liquid decanted off, and the precipitate stirred up again with some fresh, pure water made slightly alkaline with caustic soda. This should be repeated several times, then the precipitate can be filtered off and dried at 110°F. in an oven. This material can then be added directly to the cadmium bath, but a better way would be to dissolve it first in a small amount of sodium cyanide before adding it to the solution.

Zinc Plating with Impure Anodes

Question: We would like to use up some impure zinc, containing about 3% of copper, as anodes for zinc plating. We believe that if we could use an alkaline bath containing no cyanide that it might be possible to plate only the zinc, thus separating it from the copper impurity. Can you give us any suggestions on this? We do not want any copper in the plated deposit.

C. R.

Answer: We do not know of any alkaline baths for plating zinc that do not contain cyanide. It might be possible to use an acid bath, but any process such as you contemplate would produce a large amount of anode sludge, even if the copper portion of the anodes were not dissolved (which seems unlikely). The most complete study of acid zinc baths is contained in the *Transactions* of the *Electrochemical Society*, Volume 80 (1941), to which we refer you. Perhaps one of these can be found that will dissolve only the zinc portion of the anodes. Bagging the anodes and continuous filtration may then permit satisfactory plating.

If you are attempting to use scrap die-cast alloys as anodes, don't forget that these alloys also contain several per cent of aluminum, which would be ruinous to the operation of the solution. We regret not being able to seem encouraged by the prospects of success for this operation.

Controlling Weights of Silver Deposits

Question: Can you give us any information on the methods used in large silver plating plants for controlling the weight (or thickness) of the silver deposits on such items as tableware?

R. C. H.

Answer: The most common method for controlling silver deposits is by use of an ampere-hour meter on each tank. This records the total current flowing through the tank. With this information, together with a count of the number of pieces plated during the same period of time, the total weight of silver per piece (or dozen pieces) can be calculated from the electrochemical equivalent. Common practice is to take sample pieces from time to time and weigh them with and without the silver deposit as a check on the accuracy of the ampere-hour meters.

Dummy Plating Barrel Solutions

Question: We have been dummy plating our barrel nickel solution, using a flat sheet of steel. We notice that at the bottom of the dummy sheet the deposit is metallic-looking, which gradually turns to a dark gray, with no deposit at all on the top edge of the sheet. We also notice that our nickel content drops considerable overnight, and wonder what we are doing that is not right? Can you give us any information?

W. A. J.

Answer: If your barrel unit has curved anodes the answer to the problem is simple; the shorter path through the bath at the bottom of the sheet to the curved end of the anodes causes most of the current to concentrate here. This is proven by the metallic appearance of the dummy deposit, caused by too high a current density in that area. You can correct this condition by cutting off the bottom part of the dummy sheet at about the line where the dummy deposit loses its metallic look and begins to get grey or black. You can salvage the nickel on that portion of the dummy by then hanging it on the anode rod until the nickel dissolves again, but care must be taken to prevent too much iron from also dissolving.

Impurities in Copper Cyanide

Question: Can you tell us what might be the most common impurities to be found in commercial grades of copper cyanide? We are planning some work based on impurities and would like to know what to expect.

R. W.

Answer: The most common impurity would be sodium chloride and small amounts of carbonate. There would also be minute amounts of iron, tin, and silica. For research work it is suggested that you use C.P.

reagent grade materials, which give the actual analysis on the bottle labels. Commercial grades of copper cyanide can be expected to be 99% minimum pure. C.P. grades are about 99.5% pure copper cyanide.

Immersion Tin Plating

Question: We are faced with the problem of putting a thin coating of tin on some intricate assembled copper parts, and believe that the immersion method is the only one suitable for our purposes. Can you give us the formulas for the immersion tin solutions, with instructions for its use?

G. V. J.

Answer: A number of immersion tinning baths have been used, and the composition does not appear to be critical. Two of those most widely publicized are as follows:

1)	Cream of tartar	10 grams
	Stannous chloride	1 gram
	Water	1 liter
2)	Cream of tartar	4 oz./gal.
	Stanous chloride	4 "

Bath No. 1 is a laboratory bath, as the amount of tin does not permit heavy output from the bath. Bath No. 2 is a production type solution. In both solutions the parts are placed in wire trays in contact with pieces of pure zinc metal, and left in the hot (180°F.) solution for several hours. The tin deposit from these solutions will be bright, but very thin.

White Brass Plating

Question: We have heard that there is a new process for plating a white deposit on various metals that takes the place of nickel. The plating has been called "white brass," and we would appreciate any information you can give us on such a process.

K. L. C.

Answer: White brass plating is a patented process developed by DuPont a number of years ago. It was described in detail in the *Proceedings* of the 1938 Annual A.E.S. Convention, to which you are referred for complete details. The process has received quite a lot of interest recently because of the shortage and restrictions on nickel plating. However, there are a number of important considerations which must be taken into account in using the process, either as a final finish or as an undercoat for other metals. We suggest that you contact DuPont directly for further information on the feasibility of using the process on your product.

Speculum Plating as a Carburizing Stop-Off

Question: We have heard that copper-tin alloy plating could be used as a stop-off to prevent carburizing of certain areas of steel parts. Will you give us any information you have on this subject?

S. W. R.

Answer: The only commercially used copper-tin alloy plate we know of is speculum, which is an alloy having approx. 45% tin, balance copper. Such a deposit would lead to trouble in the carburizing operation, inasmuch as its melting point is about 1200°F., far below the temperatures usually used for carburizing. In addition, the speculum plating process is far more difficult to operate than regular copper baths, as well as using expensive metals for anodes. We can see no reason why speculum should have any advantage in this case.

Silver Plating Over Nickel Plate

Question: We have had some trouble with the adhesion of silver plating over nickel plate when we activated the nickel deposits in muriatic acid. Can you give us any idea what may be causing this trouble?

W. R. G.

Answer: There is always the danger of carrying some of the hydrochloric acid over into the silver solution, due to incomplete rinsing, which could cause the formation of insoluble silver chloride films on the work. This could result in poor adhesion of the subsequent silver plating. A better method would be to activate the nickel plating by a reverse current treatment in a sodium cyanide solution for about 10 seconds. No rinsing is necessary, but a silver strike is advisable in this case.

Recently Granted Patents in the Metal Finishing Field

PATENTS

Chemical Oxide Coating on Aluminum

U. S. Patent 2,550,328. *C. C. Cohn, assignor to Samuel L. Cohn and C. C. Cohn.*

The method of producing an aluminum oxide coating on aluminum or its alloys containing aluminum as their major constituent including treating a surface of such metal with an aqueous solution containing lithium, carbonate and chromate ions as its essential constituents, said solution being 0.01N to saturated in lithium ion content, 0.06N to 0.80N in carbonate ion content, and 0.07N to 0.60N in chromate ion content, and which has a pH of not less than about 9.5.

Electropolishing Aluminum Alloys

U. S. Patent 2,550,544. *C. L. Faust, assignor to Battelle Development Corp.*

A method of electropolishing aluminum and aluminum alloys containing at least 90% aluminum and not over 1% of silicon, which comprises making the aluminum the anode in a composition initially comprising essentially from 4 to 45% by weight of sulfuric acid, from 40 to 80% by weight of phosphoric acid, and from 0.2% by weight to saturation of chromic acid, maintaining a total amount of dissolved aluminum and trivalent chromium during continued operation not in excess of 6%, the balance being essentially water, and the total acid concentration being from 50 to 95% by weight of said composition, and passing a current through said composition at a temperature of from 160° to 200°F., an anodic current density of from 25 to 950 amperes per square foot and a voltage not in excess of 15 volts.

Bright Nickel Bath

U. S. Patent 2,550,449. *H. Brown, assignor to The Udylite Corp.*

A bath for electrodepositing bright nickel consisting essentially of an aqueous acid solution of a material selected from the group consisting of nickel chloride, nickel sulfate, a mixture of nickel sulfate and nickel chloride, a mixture of nickel fluoborate and nickel chloride, a mixture of nickel fluoborate and nickel sulfate, and a mixture of nickel sulfate, nickel chloride, and nickel fluoborate, said solution also containing in a concentration falling within a range of from about .1 gram per liter to saturation an organic compound soluble in the solution and selected from the group consisting of allyl sulfonic acids, allyl and vinyl sulfonamides and sulfonimides, said solution also containing in a concentration falling within a range of from about .001 gram per liter to .02 gram per liter a compound selected from the group consisting of N-aliphatic pyridinium pyrazoles and N-aliphatic quinolinium pyrazoles, the N-aliphatic group containing from 1 to 8 carbon atoms, said bath having a pH of from about 1 to 6.

Copper Plating Bottoms of Cooking Utensils

U. S. Patent 2,549,610. *J. M. Kennedy, H. J. Lee and A. P. Knight, Kennedy and Lee assignors to Revere Copper and Brass, Inc.*

The method of electrodepositing, on the bottom and contiguous lower side wall exterior surfaces of revolution of a cooking vessel, a copper coating which, on the side wall surface, is of progressively decreasing thickness as its upper edge portion is approached and merges as its upper edge into said surface, which method comprises elecdepositing the coating in successive steps, each for electrodepositing a thin layer of copper on said surfaces, by immersing only the bottom and lower side wall portions of the vessel in an electrolyte with its bottom opposed to an anode and with its axis positioned vertically, progressively decreasing the depth of immersion of the vessel for said steps, during each step axially rotating the vessel for drawing a film of electrolyte up the side wall surface above the level of the contiguous electrolyte a distance which is greater than the decrease in the depth of immersion of the vessel from the immediately preceding step and is less than the total decrease in immersion for the total number of steps, whereby the portions of the copper layers electrodeposited on the portions of the side walls in contact with said films during successive steps overlap, as do likewise the portions of said layers electrodeposited on the portions of said side walls below said films, with the upper edges of those portions of said layers at progressively decreasing distances from the bottom of the vessel.

Absorbent Anodic Coating on Aluminum

U. S. Patent 2,550,388. *E. Simon and F. M. Carasso, assignors to Lockheed Aircraft Corp.*

An electrolyte for the anodic oxidation of aluminum and alloys thereof to produce an absorbent coating, said electrolyte comprising an aqueous solution containing from 10% to 20% by volume of sulfuric acid, and approximately 0.1% by volume of a nonionic wetting agent consisting of iso octyl species of alkylated phenoxy polyethoxy ethanols.

Lubricating Conversion Coating for Stainless Steel

U. S. Patent 2,550,650. *P. Amundsen and J. A. Henricks, assignors to Parker Rust Proof Co.*

In a process for treating the surfaces of stainless steel to facilitate cold

drawing by producing an adherent coating thereon, the novel step of immersing the stainless steel in an aqueous bath consisting essentially of oxalic acid, a sulfur compound containing oxygen which yields sulfur dioxide and sulfur under the conditions of the coating bath, and an activator consisting of a soluble alkali halide, for a time interval sufficient to form a substantial coating and at a reactive temperature within the range of from approximately room temperature to approximately 190°F.

Bonding Rubber to Plated Deposits

U. S. Patent 2,551,342. *E. L. Scholl, assignor to United States Rubber Co.*

The method of bonding an electrodeposited layer of metal to rubber so as to secure a strong bond therebetween, comprising the steps of providing a layer of rubber, treating a surface thereof with phosphorous trichloride, then coating the treated surface with electrically conductive particles to render it electrically conductive, and electrodepositing directly thereon a layer of metal selected from the group consisting of iron and nickel in direct contact with the rubber so that the metal is bonded directly and strongly to the treated surface of the rubber.

Bonding Rubber to Plated Deposits

U. S. Patent 2,551,343. *E. L. Scholl, assignor to United States Rubber Co.*

The method of bonding an electrodeposited layer of metal to rubber so as to secure a strong bond therebetween, comprising the steps of providing a layer of rubber, treating a surface thereof with chloroacetyl chloride, then coating the treated surface with electrically conductive particles to render it electrically conductive, and electrodepositing thereon a layer of metal selected from the group consisting of iron and nickel in direct contact with the rubber so that the metal is bonded directly and strongly to the treated surface of the rubber.

Bonding Rubber to Plated Deposits

U. S. Patent 2,551,344. *E. L. Scholl, assignor to United States Rubber Co.*

The method of bonding an electrodeposited layer of metal to rubber so as to secure a strong bond therebetween, comprising the steps of providing a layer of rubber, treating a surface thereof with bromine, coating the treated surface with electrically conductive particles to render it electrically conductive, and electrodepositing thereon a layer of metal selected from the group consisting of iron and nickel in direct contact with the rubber so that the metal is bonded directly to the treated surface of the rubber by the electrodepositing operation and forms a bond capable of resisting a pull of hundreds of pounds per square inch in shear.

Diffused Silver Alloy Bearings

U. S. Patent 2,551,413. *J. M. Booe, assignor to P. R. Mallory & Co., Inc.*

The method of forming a bearing alloy which comprises electroplating successive layers of indium, thallium and indium over a silver base and subjecting the resulting combination to heat treatment for about 6 to 12 hours at a temperature of about 500 to 600° C. to cause diffusion of the thallium and indium into the silver and the formation of a thallium indium silver alloy.

Automatic Polishing Machine

U. S. Patent 2,552,194. *E. C. Lindsay and G. M. Hurley, assignors to Standard Steel Spring Co.*

Apparatus for conveying a curved workpiece to be polished past and in contact with a polishing device, which comprises a track, a carriage located above said track and means for moving it along the track, a table pivotally mounted on top of the carriage, the table comprising an upper part and a lower part hinged together adjacent one end, the opposite end of said upper and lower parts having resilient means interposed between them, means on said upper part for rigidly mounting the workpiece thereon, a sinuous cam extending lengthwise of the track, and a cam follower connected to said table and cooperating with said cam for oscillating said table and the workpiece mounted thereon relative to said carriage as they move past the polishing device.

Abrasive Belt

U. S. Patent 2,552,774. *J. L. Fihe, assignor to The B. F. Goodrich Co.*

A high speed band for supporting polishing material, said band comprising a layer of tension-resisting elements extending lengthwise of the band in substantially parallel relation, a backing layer of extensible plastic material on one face of the tension resisting elements, and a face layer of textile material at the opposite face thereof, said face layer having an exposed face substantially free from coating material for mounting an abrasive material thereon and being extensible in the lengthwise direction of said tension-resisting elements and attached thereto by an intervening layer of resilient rubber material for relieving said face layer of substantially the entire tension load on the band and imposing substantially all such load on said tension-resisting elements.

Phosphate Treatment for Steel

U. S. Patent 2,552,874. *E. Snyder and F. P. Heller, assignors to American Chemical Paint Co.*

In the art of phosphatizing ferriferous surfaces, the method which includes treating the surface with two successive baths each consisting essentially of an aqueous solution of both primary and secondary phosphates from the class which consists of alkali metals and ammonium, the second of said baths being adjusted to a pH of from 4.7 to 6.2 and the first to a pH which is at least 0.2 unit lower than the second but never below a pH of 4.

Acid Tin Plating Bath

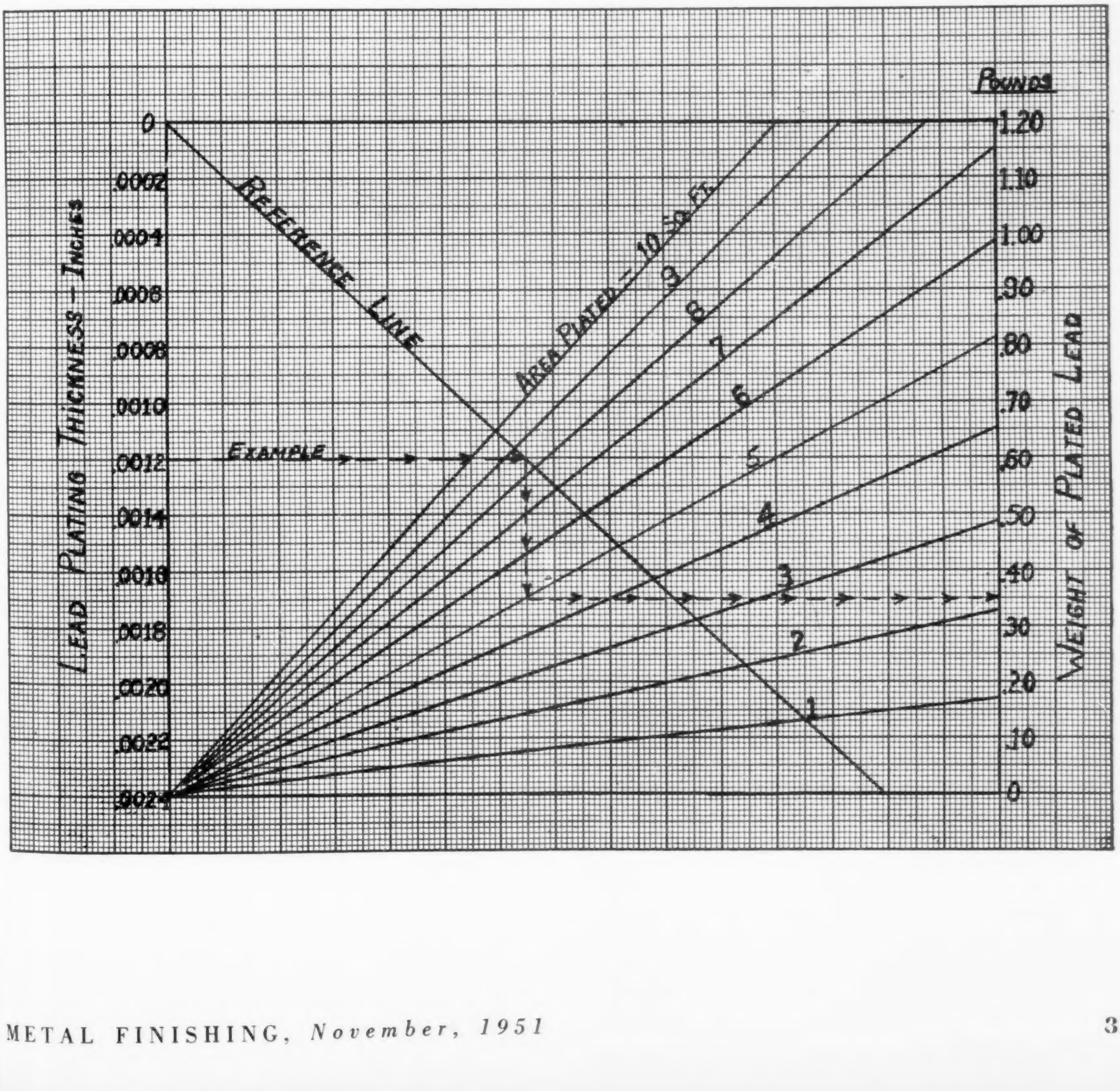
U. S. Patent 2,552,920. *W. S. Allen, assignor to U. S. Steel Co.*

An electrolytic tin plating bath consisting essentially of an aqueous acid solution having a maximum pH value of 2, of 10 to 80 grams per liter of tin in the form of a stannous salt of an acid of the group consisting of sulfuric acid, phenolsulfonic acid and hydrofluoboric acid and 0.2 to 7.0 grams per liter of an addition agent which is a polymer of a monomer of the group consisting of: 2,2,4 trimethyl-1,2 dihydroquinoline, 2,2,4,8 tetramethyl-1,2 dihydroquinoline, 2,2,4,7 tetramethyl-1,2 dihydroquinoline, 2,2,4,6 tetramethyl-1,2 dihydroquinoline, 2 methyl 2,4 diethly-1,2 dihydroquinoline, 2,8 dimethyl 2,4 diethyl-1,2 dihydroquinoline, 2,7 dimethyl 2,4 diethyl-1,2 dihydroquinoline, and 2.6 dimethyl 2,4 diethyl-1,2 dihydroquinoline.

Calculating Metal Cost for Lead Plating

The chart below simplifies the metal weight and cost calculations for lead plating. The example shown is for calculating the cost of plating .0012" of lead on a surface area of 5 square feet. Heavier or lighter coatings than shown in the table can be calculated using appropriate factors.

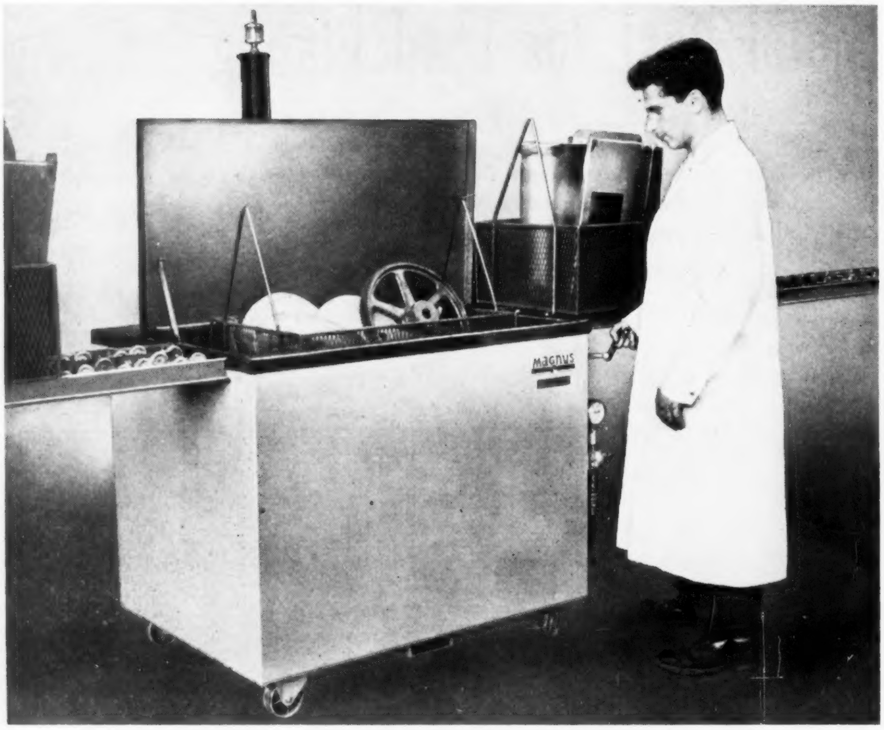
Metal weight multiplied by the cost per pound of lead anodes gives the total metal cost.



Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

All-Purpose Cleaner for Metal Parts



Magnus Chemical Co., Inc., Dept. MF, South Ave., Garwood, N. J.

Following extensive field tests, the above company announces Magnus 751, a new and highly effective cleaner for all kinds of metal parts.

It is claimed to be safe for all metals, not attacking, pitting or marring aluminum alloys, bearing metals, cadmium, solder, die cast or any other soft metal. It is non-inflammable. It cleans at very high speed, penetrating, loosening and removing all foreign deposits faster and better than ordinary cleaners, according to the firm. A noteworthy characteristic is the extremely long life of the cleaning solution. Cleaning costs are very low, because of this feature. Magnus 751 can be used in either hot or cold solution and is followed by a simple cold water rinse after the cleaning period.

An outstanding use of this cleaner is the removal of carbonized oil and gums from aircraft engine parts, diesel engine parts and other units where these stubborn deposits cause trouble when ordinary cleaners are used. It is also recommended for cleaning carburetors, fuel pumps, pistons, rocker arm assemblies, rear and transmission parts, brake parts, etc.

Because of its complete safety where any metal is concerned, Magnus 751 will have great value in all kinds of cleaning operations on industrial equipment parts. Work can be placed in the cleaning solutions and simply left there until it is needed. A pressure spray rinse with water or with safety solvent, gives you a part ready for use, thoroughly cleaned, it is claimed.

Where a large volume of parts has to be cleaned regularly, this cleaner works best when used in the Magnus Aja-Dip cleaning machine, where agitation speeds up the cleaning action and all traces of deposits are removed, making hand brushing unnecessary. This cleaner also strips paint and other coatings from the parts it cleans.

Magnus 751 closely follows Navy Aeronautical Specification C-86 and Army-Navy Aeronautical Specification AN-C-163.

Tumbling Machine

Grav-i-Flo Corp., Dept. MF, 400 Norwood Ave., Sturgis, Mich.

The above firm has added a new model tumbling machine to its line of equipment for use with the Grav-i-Flo tumbling process. With two 18" x 40" I.D. compartments, the new model 36-2 machine offers increased capacity per area of floor space over previous equipment, permitting the grinding, de-burring and finishing of metal parts in larger quantities in faster time cycles.

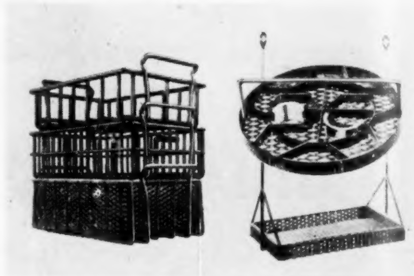
Other outstanding features: compartments are furnished with 1/2" plate unlined or 1/4" plate rubber-lined; doors have cam locks with manually released safety stops to provide pressure relief; magnetic starter has a reduced voltage control to meet plant electrical standards. A lever is standard on the machine but a push button switch is optional; a limit switch on the safety guard cuts off current to stop barrel rotation when guard is lifted. The 220-440 volt, 5 H.P. motor has a magnetic brake. Water and electrical services are integral with the machine and available for instant, con-

venient connections. Safety guard is counterbalanced for easy lifting. Hoist pan has tubular yoke with unusually operated lock.

For full information about the new Grav-i-Flo machine and process, write to the above address.

Rubber-Covered Handling Equipment

Automotive Rubber Company, Inc., Dept. MF, 8601 Epworth Blvd., Detroit 4, Mich.



With the call for faster production in the country's factories—and more and more precise and fragile parts being specified, planning engineers are finding that the extra cost of tough, yet soft rubber and synthetic covering on material handling equipment is being paid for quickly in savings on 'rejects.'

While Automotive Rubber Co. actually merchandises very few 'across-the-counter' items, their engineers have been a factor in the development of rubber-cushioned handling baskets, pans, spacers, chutes, hooks, racks, etc., making it possible to safely handle larger quantities of fragile parts faster and without slippage, marring and scratching.

Even the precision inspection on Air Corps and Army Ordnance parts can be satisfied when handled with rubber protection using ARCO's seamless dip process or sheet lining. Product control can be effected with the purest of rubber or with synthetics where unusual conditions are to be met.

Tantalum Heating Coils and Heat Exchangers

United Chromium, Inc., Dept. MF, 100 East 42nd St., New York 17, N. Y.

Tantalum heating coils that possess several advantages over coils made of other material are now supplied by United Chromium. Heat exchangers also are available, utilizing the superior tantalum tubing. Both coils and exchangers can be obtained in standardized units or made to order.

Unichrome tantalum heating coils and Unichrome tantalum heat exchangers promise durability. Tantalum is virtually acid-proof, resistant to all of the acids commonly found in the plating room, except straight hydro-

fluoric acid. It is especially recommended for chromium plating solutions, that are so severe on the lead coil or special alloy heat exchangers generally used. The advantage here is not only long life but also freedom from the corrosion and sealing that form heat-insulating coatings and present a maintenance problem. Tantalum tubing stays clean and shiny. While excellent for acid solutions, tantalum should not be used in alkaline baths where ordinary iron or steel serves quite well.

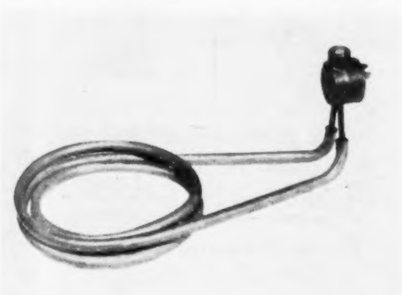
Tantalum tubing can make possible substantial savings in both heating and cooling. Tantalum possesses heat conductivity better than steel and superior to any lead alloy. The great strength of tantalum permits the use of tubing with thin walls, with no allowance necessary for loss of strength due to corrosion. Good conductivity plus thin walls provide fast heat transfer with minimum lag and therefore much closer regulation of bath temperatures.

Unichrome tantalum heating coils and unichrome tantalum heat exchangers can be used for both heating and cooling. They are not subject to damage from thermal shock. Experience to date shows that tantalum, now being used in chromium plating baths, will out-last the best lead alloys by a wide margin. This longer service life not only cuts down on replacement coils and the labor costs of replacing them, but also reduces the loss of costly solution through coil failure.

Immersion Heaters

General Electric Co., Dept. MF, Schenectady 5, N. Y.

The re-design of two Calrod immersion heaters, for nickel and copper plating baths and for mild sulphuric



acid and chrome plating baths, has been announced by the Industrial Heating Dept. of the above company.

Greater flexibility and portability have been incorporated in the new

units, according to G-E engineers, by replacing the old-style sealing cup with a new junction-box of terminal housing which is vapor-tight. The new terminal housing is easier to repair in the field, and relocation of the unit is more quickly accomplished, they said. In addition, the housing reduces the possibility of faulty connections, and the terminals are readily accessible by removing the housing cover so the terminal connectors to the leads are exposed.

To relocate the heater the operator has only to remove the cover, disconnect the wire from the heater, place the heater wherever he desires it, and then rewire. Either flexible leads or rigid conduit can be used.

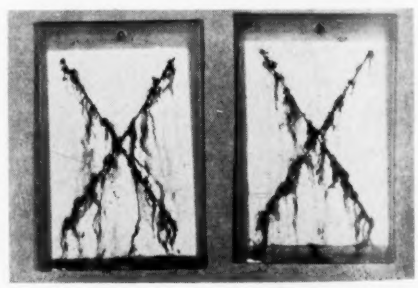
Standard advantages of the G-E immersion heater are ease of installation, long life, portability, and its quarter-inch thick lead outer sheath which protects it from the corrosive action of many acid solutions.

Phosphating Cleaner With Triple Action

Wyandotte Chemicals Corp., Dept. MF, Wyandotte, Mich.

Wyandotte Pre-Fos, marketed by the above firm, is a triple-action material. It cleans, deposits a fine-grained phosphate coating, and prevents rust of in-process steel parts, it is claimed.

Pre-Fos has been field tested for almost a year, and is said to reduce consumption by 25% and provide an excellent base for paint.



It can be used in spray washers or soak tanks, in hard or soft water, and does not corrode mild steel equipment. It is claimed the life of painted metal products is greatly increased.

Power Brushes Clean Razor Blade Strip

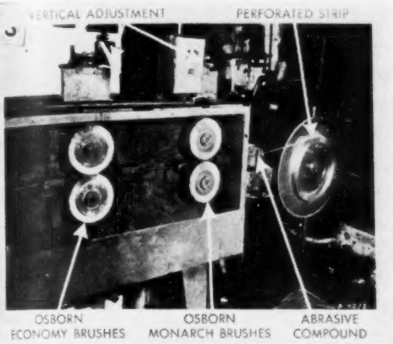
Osborn Mfg. Co., Dept. MF, 5401 Hamilton Ave., Cleveland, O.

By combining two individual production processes into one automatic brushing operation, manufacturers of

razor blades are saving hundreds of dollars, and in addition are obtaining higher quality finishes, according to the above firm.

The two jobs done by the power brushes (1) removing heat treat scale, and (2) preparing the strip surface for name etching.

The razor blade strip is pulled through the Osborn brushes at 50 feet per minute. The brushes rotate at 3450 revolutions per minute. As they become grooved from wear, they are reversed. Bevel gears move the brushes up or down as required.



These two stations do the work of six stations of the former method. The strip comes out uniformly clean and micro-smooth ready for name etching, it is claimed.

Bright Zinc Process for Still Tank Plating

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

One of the latest exclusive developments to be introduced to the plating industry by the research laboratories of this firm is a new bright zinc process, BSZ-300.

H-VW-M BSZ-300 process is a simple, economical method of producing bright to brilliant deposits directly from the plating bath. Bright dipping is not essential. Parts plated by this new process not only appear brighter, but they stay bright longer and have higher resistance to oxidation and tarnish, it is claimed. The use of BSZ-300 is said to provide greater corrosion protection for plated parts as well as sharply increased visual sales appeal.

This new bright zinc process requires no special equipment of any kind. It is based on use of the BSZ-300 Brightener as an additive to the regular cyanide solution. Requiring only low concentration in the plating bath and having a low consumption rate, BSZ-300 can be economically used right from the start.

This solution may be used with equally satisfactory results over a broad range of current densities, and has exceptional tolerance for impurities, according to the firm. It readily accepts conversion coatings and can be soldered with comparative ease. In addition to non-critical operation and control, its excellent covering power makes the BSZ-300 process efficient, simple and economical.

Full details regarding technical methods of operation are available on request.

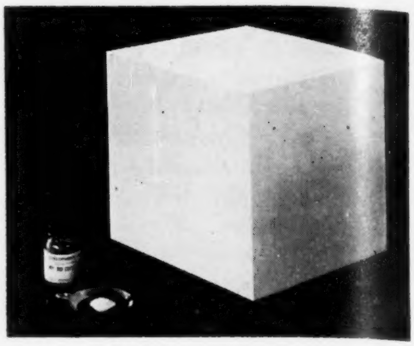
New Product Provides Rust Proofing Without Coatings

Shell Oil Company, Dept. MF, 50 W. 50th Street, New York 20, N. Y.

An economical method of preventing rust and corrosion of metal parts, in the presence of air and moisture, is provided by "VPI" crystals, a slightly volatile amine nitrite now being made available to industry by the above firm. This volatile corrosion inhibitor is now being used in protecting metal parts, assemblies, instruments and finished products during shipment, storage and through various processing steps.

Being slightly volatile at atmospheric temperatures, VPI gives off vapors which are carried by convection and diffusion to all surfaces of the metal, where they condense to provide a thin protective layer.

VPI, a powder-like substance, can be applied by placing it in a package enclosing the parts to be protected (as



in an envelope containing ball bearing races); by blowing it into an area to be protected (as in the aircraft engines, where it is blown into spark plug holes, cylinder bores, and other ports); by putting it into a water or alcohol solution (as in the protection of metal parts during and between processing steps such as grinding) and covering the metal parts in tote boxes. An unusual characteristic of VPI is that it will arrest corrosion at any advanced stage.

When using VPI, ventilation of the enclosure in which parts are stored should be kept to a minimum to insure the maximum protection period, and the parts should be no further than 2 feet from the VPI source. Metal parts protected by VPI are ready for instant use since there is no grease or oil to remove. Relatively small quantities of VPI, established by practice, are required to give adequate protection. It is claimed that one gram of VPI will protect a cubic foot of metal parts, or surface, for periods up to a year. Solutions of from 2% to 4% are effective in protecting processed metal parts. Two types of VPI are available; VPI 220, which has greater vapor pressure but less stability at higher temperatures than VPI 260, which is more widely used by industry.

Although VPI is just now being offered to industry on a broad basis it has been proved effective in preventing costly corrosion, under difficult condiitons, in aircraft engines, precision instruments, tools and dies, Diesel engines and parts, sand blasted parts, continuous steel strip, steel rods, steel forgings, ball and roller bearings, water pumps, large fabricated sheet metal components, stamped parts which are to be plated, and tank trailers.

VPI crystals have also been used as inhibitors in hydraulic fluids; and in water soluble paints to provide the corrosion resistance necessary in a general purpose industrial coating.

Addition Agent for Tin Plating

American Cyanamid Co., Dept. MF, 30 Rockefeller Plaza, New York 20, N. Y.

This company has introduced a new product, Aerobrite, an addition agent that will be marketed to the steel industry as an aid in cold drawing, porcelain enameling and tin plating.

In preparing steel for cold drawing, the addition of a minute quantity of Aerobrite to the pickling bath results in brighter steel and the removal of surface iron salts harmful to expensive dies, it is claimed. It has been reported that the chemical also increases the life of the pickling bath.

In nickel plating steel sheets before porcelain enameling, the new product can be used as a relatively non-toxic and cheaper replacement for sodium cyanide to remove iron salts from the nickle's surface.

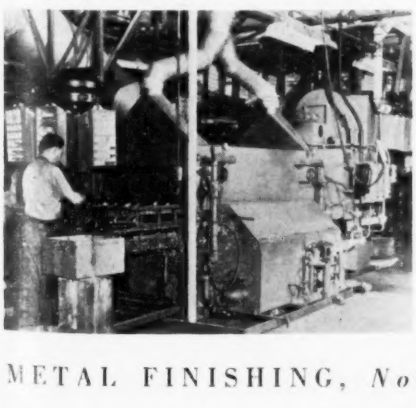
In the tin plating process, Aerobrite prolongs the life of the baths by eliminating sludging, it is claimed.

It is believed that the new pickling bath additive forms a complex molecule in the solution, thereby eliminating the heavy metal ions which impair the quality of the finished product.

Machine Cleans Buffed Parts

Industrial Washing Machine Corp., Dept. MF, New Brunswick, N. J.

The efficient removal of buffing compound from polished vacuum cleaner parts is the specific function of this washer, installed in the *Electrolux Corp.* plant at Old Greenwich, Conn. With a high production rate of 900 square feet per hour, model CT 36 x 10 performs the difficult task of completely removing caked buffing compound from parts while saving the labor of three employees. The machine, which occupies a surprisingly small area for its accomplishments, is heated by steam. Its operation is completely automatic . . . it washes, rinses and dries the work and delivers it ready for color buffing. Further facts and any additional information desired will be promptly supplied upon inquiry.



Blackening Processes

Swift Industrial Chemical Co., Dept. MF, Box 2189, Hartford, Conn.

This firm announces a complete line of blackening baths for all the common metals, including cast and malleable iron. Five different baths are available, each compounded for imparting a deep lustrous black on a specific metal or alloy of that metal. Zinc, copper alloys, carbon and alloy steels, cast iron are all included in the list of metals that can be treated. Complete information and literature is available by writing to the above address.

Phosphate Process for Steel

Detrex Corp., Dept. MF, Box 501, Detroit, Mich.

This firm announces a new phosphating process for steel, called Perm-Cote, which is claimed to have the following features:

1) Greater corrosion protection.
2) Pleasing appearance.
3) Simplicity and economy.

Two formulations are available—one for heavy crystalline coatings, the other for fine, dense crystalline coatings. Complete details and specifications are available by writing to the above address.

Polystyrene Film Added to Metallized Line

Coating Products, Dept. MF, 136 W. 21 St., New York, N. Y.

The metalization of polystyrene film through their special processing techniques has been achieved by the above firm according to an announcement by *Mr. M. Mainthow*, Sales Director, and is now available in a complete range of colors and finishes.

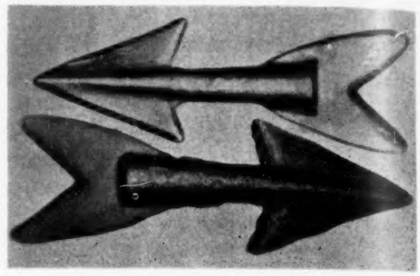
Hitherto, the unique visual effects of metallics, gleaming golds, silvers, bronzes, coppers and other colorful finishes were limited to applications on cellulose acetate. The addition of polystyrene to their present line permits this firm to offer extra advantages inherent in the material, such as electrical applications at all frequencies, low moisture absorption, and light conductivity.

Applications for metalized polystyrene will run the gamut from display packaging, electric insulation uses, toys, venetian blinds, greeting cards, calling cards, index dividers, light conductors for three-dimension advertising, advertising media by mail, place mats, and uses employing its very low water absorption rate, as well as varied usages including replacements due to metal shortages.

Available in gauges .003, .005, .0065, .0075 and .010 in 20″ and in rolls 500 feet to 1000 feet on 3″ I.D. cores. Rolls can be slit or sheeted to specific requirements.

Compound for Barrel Finishing Brass, Bronze, Copper, Gold and Silver

Blue Magic Chemical Specialties Co., Dept. MF, 2135 Margaret St., Philadelphia 24, Pa.



A special purpose chemical for barrel finishing brass, bronze, copper, gold and silver stampings, castings, machined and drawn parts is offered under the trade name Blue Magic Compound No. 1 Double Strength. This compound is a highly concentrated paste for use in very small quantities and is said to yield beautifully uniform metallic colors and finished in extremely short time cycles.

Blue Magic No. 1 is recommended by the manufacturer for finishing either with or without media, and with selected non-ferrous media for roughing, deburring, cleaning and finishing in a single operation. Recommended quantities are only 4 oz. of compound for finishing runs in a 32″ x 30″ tumbling barrel at high water level. As a cutting compound in deburring operations you need only 1 oz. to 2 oz. of compound at low water level in the barrel.

Principal advantages claimed are economy, fine finish, uniform metallic colors, greatly reduced time cycles on all operations.

Polyethylene Valves

American Agile Corp., Plastics Div. Dept. MF, 5806 Hough Ave., Cleveland 3, O.

This firm offers 1″ and 2″ bore valves which are fabricated throughout from polyethylene, except for the packing rings, made from a polyethylene-polyisobutylene mixture.

These valves known as Agilene valves, are extremely light in weight (1 lb. and 3¼ lbs. respectively) and are highly resistant to most corrosive chemicals including hydrofluoric, sulfuric, nitric and hydrochloric acids at temperatures up to 170°F.

More resistant to most commonly-encountered corrosive media than

stainless steel, monel, and other high-priced metals and alloys, Agilene valves are furnished with standard drilled flanges for easy incorporation into existing installations or for use in new pipe line assemblies.

Buffing Compositions for Chromium Plate and Stainless Steel

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

This firm presents a rounded-out line of buffing and polishing compositions for the plating and polishing industry. These composiitons are listed and described in detail in their new Bulletin C-100. Of special note, however, are the compositions for chromium plate and stainless steel, as follows:

6-B-72: Extremely high coloring. Made from the finest aluminum oxide flour; will not scratch. Suitable for use on highest grade chromium finishes ranging up to jewelry.

6-B-86: A white production rouge with a hard binder for carbon or stainless steel or chromium plate. Excellent for plumbers' goods and automobile accessories. Produces high color. *Economical.*

6-B-66: Made from specially selected aluminum oxide flour. Well balanced for general use, where fast cutting and good coloring are desired. *Economical.*

6-B-97: Exceptionally fast cutting for carbon or stainless steel; molded in rectangular shaped bar for hand or automatic application; fair color.

Complete details available by writing.

New Portable Tumbler-Mixer

Rampe Manufacturing Co., Dept. MF, 3320 St. Clair Ave., Cleveland 14, O.

This machine, low cost, portable, universal Tumbler-Mixer that will mix or tumble almost anything, can be quickly moved from one job to another. It tilts through a full 90° arc so that the work can be tumbled at the best angle.

The Tumbler-Mixer is adapted to many uses, due to the adjustable turn table clamps that allow standard and odd shaped containers to be used. Easy to hold a 5-gallon pail, wooden box, can, jug, stone ball mill, laboratory beaker or any other container. Regular steel octagonal tumbling barrels or hexagonal burring barrels are available as extra equipment.

Ideal for small lots in large or small shops, experimental departments, laboratories, chemical plants, etc. Can also be used to mix paints and add colors to plastic granules.

Specifications include anti-friction bearings throughout, 1/6 H.P. motor, 19" turn table. Floor space required 19" x 32" x 35" high. Weight 80 pounds.

Foam Suppressor

Guild Laboratory, Dept. MF, P.O. Box 3194 Barnum Station, Bridgeport, Conn.

This firm announces a new addition to its line of chemicals in conjunction with its electroplating research activities. A very effective foam suppressor, known as Gilab Suppressor "F," is now available to the industry.

When this suppressor is sprayed on top of alkali baths it disperses foam

suds completely. The use of this suppressor imparts an important safety feature by preventing explosions which are common to electric cleaners. Also, a production advantage is gained since its use permits air aggitation without overflowing tanks or clogging air vent ducts. Foam in tumbling barrels can also be controlled by this suppressor.

A spray syringe applicator is furnished with Gilab Suppressor "F" for the user's convenience.

New Surfactant Acid By Increasing Drain-Off

Nopco Chemical Co., Dept. MF, Harrison, N. J.

Nopco 1067-A, a new surface tension depressant, especially designed for use in mineral acid solutions, is said to show unusual promise for use in pickling, anodizing, wire treatment and similar metal working operations.

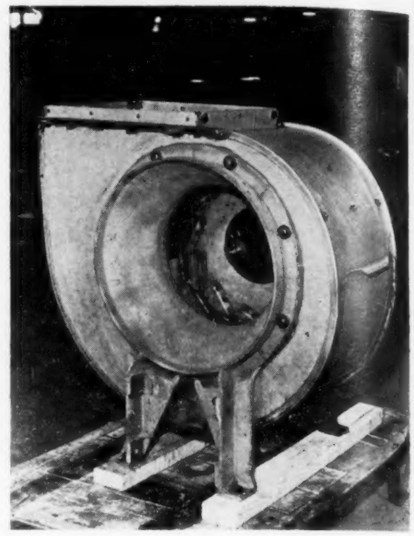
Plant performance tests show striking benefits in saving of acid by increasing drain-off of pickling solution from metal work and in reducing acid contamination in subsequent handling. Low surface tension values are maintained in cold and hot sulfuric and other acids in concentrations up to 25%.

In certain processes where fuming occurs, the use of this new surfactant has made possible the elimination of expensive exhaust fan systems, it is claimed.

Technical literature describing the desirable effects of Nopco 1067-A in acid solutions is available.

Fan for Corrosive Fumes

Clarage Fan Co., Dept. MF, Kalamazoo, Mich.



A new product of this firm is a fan made of a recently introduced corrosion-resistant material.

Blades, housing and other vital parts such as bolts, nuts, etc. are made from a comparatively new stainless steel, called Carpenter No. 20. Previously available only in cast form known as Durimet 20, the wrought material made by *The Carpenter Steel Co.* provides excellent resistance to sulphuric and nitric acids and their fumes.

Protective Coating

Flash-Stone Co., Inc., Dept. MF, 30 E. Rittenhouse St., Philadelphia 44, Pa.

Coal tar pitch has been compounded by a recently developed process into a fast drying protective coating by breaking it down into minute molecules, then combining it with water and a stabilizing emulsification agent to form a permanent suspension that can be brushed or sprayed.

Available under the trade name "Tarlac", this new coating is said to retain all the excellent protective and adhesive qualities of coal tar pitch, to be impervious to oils, greases, other petroleum derivatives, acids, alkalis, water and condensation. It will not crack at low temperature or run at high temperature, it is claimed. Good from—56° to 200°F. Recommended as a protective coating for concrete structures, floors, masonry, etc., metals exposed to corrosive elements, mastic floors or other black top surfaces, wooden platforms and other wood exposed to the elements, also for other general protective purposes.

"Tarlac" dries to a tough, enduring,

flat black film, is completely insoluble in water, oil or gasoline, is thinned when necessary with water, and covers up to 300 sq. ft. per gal. . Comes in 5 gal. pails.

Carbon Heat Exchangers

British American Carbon Corp., Dept. MF, 18 East 48th Street, New York 17, N. Y.

A newly designed heat exchanger, developed in Great Britain, is now available to the American chemical process industries. The unit consists principally of a compact cube of "Delanium" carbon, a new elemental carbon product. The "Delanium" heat exchanger is much smaller than a conventional heat exchanger of comparable performance. It is of rugged construction and can be installed readily either singly or in banks. It is particularly useful with corrosive liquids such as most alkalis, salt solutions, organic chemicals and all except the most highly oxidizing acids.

Vacu-Blaster Blast Cleaner

Vacu-Blast Co., Dept. MF, 350 Peninsular Ave., San Mateo, Calif.

A new catalog issued this month by this firm tells in detail uses and advantages of the company's "Vacu-Blaster"—a compact, movable blast-cleaning equipment for metal, concrete, brick, stone or wood surfaces.

The catalog contains numerous drawings and action photos showing how Vacu-Blaster works. Special sections explain advantages of the unit in welding operations, and in the maintaining of rolling stock, plants and buildings. Another section deals with unusual or difficult blast-cleaning applications such as metal patterns, molds, storage tanks, armatures, steel drums, concrete surfaces, etc. The catalog gives operating details on the Generator-Reclaimer and Dust Collector units which comprise the complete Vacu-Blaster; on accessories such as special blast guns, cabinets, nozzles and abrasives, and on Vacu-Veyor, a companion equipment designed for high-speed transfer of bulk granular materials.

Vacu-Blaster is described as the only blast-cleaner with a dustless vacuum pickup which removes abrasives and debris simultaneously with the blasting operation. Painters, welders, etc. can work right alongside the Vacu-Blast operator without masks or other protective devices, it is claimed.

Manufacturers' Literature

Rectifiers and Periodic Reversers

Rapid Electric Co., Dept. MF, 2881 Middletown Rd., Bronx 61, N. Y.

A new booklet just published by Rapid Electric is a complete compilation of data and specifications on their line of selenium rectifiers and periodic-reverse current devices for the plating industry. The various features of Rapid equipment are pictured and described in an easily understood fashion.

Automatic controls and accessory

equipment is also included. Copies may be obtained by writing to the above address.

Vapor Degreasing Solvents

Detrex Corp., Dept. MF, Detroit 32, Mich.

A data sheet recently published by this firm gives all the known technical information on trichlorethylene and perchlorethylene vapor degreasing solvents. Physical and chemical properties, purchase specifications, boiling points of oil-solvent mixtures, packaging information, stability data, are some of the subjects covered. Write to the above address for your copy of this informative bulletin.

Water De-Mineralizers

Penfield Mfg. Co., Dept. MF, 19 High School Ave., Meriden, Conn.

A new, 4-page catalog describing water conditioning equipment for boiler feed, process and other industrial needs is announced by the above firm.

One of the original and also largest manufacturers of ion exchange systems, Penfield now serves industry with a complete line of water conditioning equipment—softeners, de-alkalizers, degasifiers, filters, storage tanks, and other water treating accessories, as well as single, double and four column demineralizers.

Penfield"s "Planned Purity" method of planning water treating methods specifically for the various standards of purity and quantities required, often enables Penfield engineers to suggest a multiple-use water conditioning system which, while holding equipment investments to a minimum, makes important contributions both to reduced plant operating costs and to improved process or end product results.

Readers may secure copies of this new Penfield catalog by writing.

Metallic Rectifier Power-Conversion

General Electric Co., Dept. MF Schenectady 5, N. Y.

A new two-color booklet on the G-E metallic rectifier power-conversion units has been announced as available.

Designated as publication GEA-5658, the bulletin describes the features of the equipment, its application and operation. It is illustrated with photographs, line drawings and charts showing efficiency and regulation curves for the various sized units.

A specification guide for General Electric d-c power supplies and exciters is also included, as well as complete rating charts and dimensions.

Buffing and Polishing Compositions

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

A large illustrated bulletin covering bobbing composition, crocus compositions, chromium coloring compositions, emery paste and cake, greaseless compositions, hard rubber and plastics compositions, lime compositions, lime (powdered and lump), liquid compositions (Acme), liquid composition equipment, polishing tallow, principal classifications of buffing compositions, pumice, powdered and lump, recommendation chart and index, rouge (bar and powdered), stainless steel and carbon compositions, Tripoli compositions, Tripoli (powdered), water dispersible compositions and white coloring compositions.

Liquid Level Controllers

Minneapolis - Honeywell Regulator Co., Dept. MF, Wayne & Windrim Aves., Philadelphia 44, Pa.

Specification Sheet No. 412-2 covers Honeywell internal float and external float cage liquid level controllers, used to maintain liquid level in tanks.

The sheet gives pertinent specification data such as sizes, construction,

materials, ratings and complete dimensions for mounting. Copies may be obtained by writing to the above address.

Grinding & Polishing Machinery

Hammond Machinery Builders, Dept. MF, Kalamazoo, Mich.

A new Grinding, Polishing & Buffing Machinery Catalog, No. 75, has recently been published by this firm.

It is punched to fit the Hammond Manual. The new Catalog No. 75 supersedes Catalog No. 325 and also includes—

- General Purpose Grinders.
- Five Polishing Lathe Models.
- Duskolectors.
- Present model Backstands. Catalog No. 325 showed the old style.

Copies may be obtained by writing to the above firm.

Airless Blast Cleaning

American Wheelabrator & Equipment Corp., Dept. MF, 555 S. Byrkit St., Mishawaka, Ind.

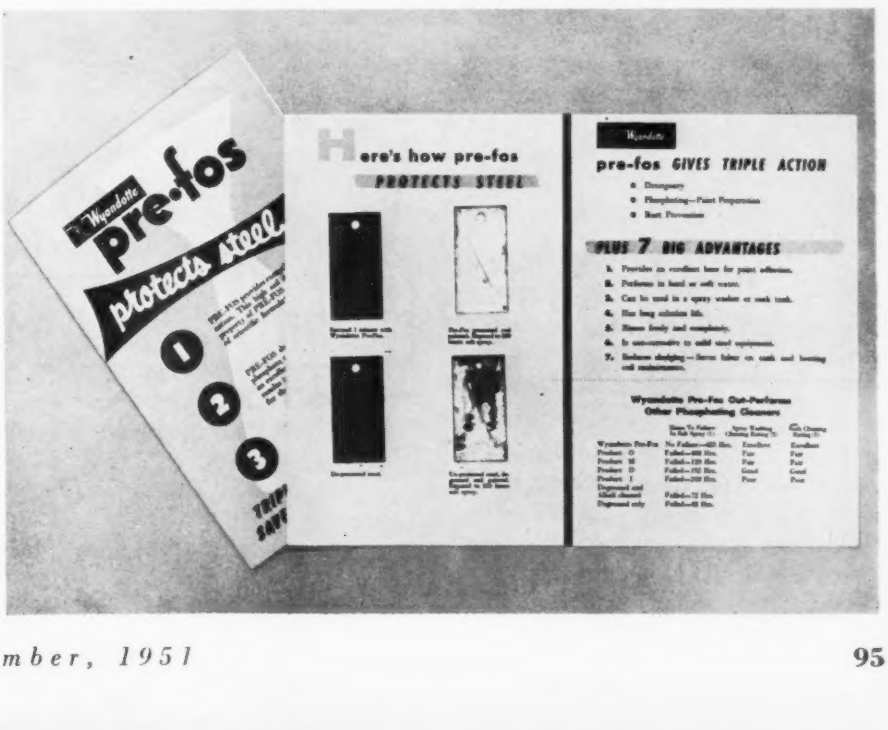
How airless abrasive blasting can be applied to solve the cleaning problems in industries concerned with ordnance material production is explained in a new bulletin recently published by the above firm. Covering fields such as the cleaning of shells and bombs, tank parts, artillery components and aircraft engine parts, the illustrated brochure shows some machines which are already in use for preparing the surfaces for bonderizing, aluminum metallizing, cadmium plating, and for rubber coating. Applications of airless blasting for removing rust, scale, and sand from castings, forgings, and heat treated parts are also described.

Copies may be obtained by writing to the above firm.

Cleaning and Phosphating Material

Technical Service Dept. J. B. Ford Division, Wyandotte Chemicals Corp. Dept. MF, Wyandotte, Mich.

A new circular, Form 1297, "Wyandotte Pre-Fos Protects Steel," contains four actual samples of protected and unprotected in-process steel. Wyandotte Pre-Fos, developed by the company's research division, is a triple action material—it cleans, deposits a fine-grained phosphate coating and



prevents rust, the manufacturer claims. Technical information concerning the processing of these and other steel sheets is given.

Requests for Form 1297 should be mailed to the above address.

Pyrometers and Resistance Thermometers

Minneapolis-Honeywell Regulator Co., Dept. MF, Wayne and Windrim Aves, Philadelphia 44, Pa.

The above firm announces an 8-page illustrated Bulletin 1051 describing a new line of non-control pyrometers and resistance thermometers, which use the same high resistance plug-in galvanometer unit and two-compartment case employed in their well-known line of Pyr-O-Vane and Protect-O-Vane electric contact controllers. Includes wiring diagrams and circuit information of pyrometer, resistance thermometer, tachometer and other actuations. Copies may be had by writing to above address.

Letter to the Editor

Likes Our Suggestions for 1952 Exposition

Mrs. Joan Wiarda, Sales Mgr.
Metal Finishing
New York, N. Y.
Dear Joan:

At a recent meeting of the Industrial Finishing Exposition Committee I was authorized to convey to you the gratitude of the committee for the splendid suggestions regarding the exposition which you gave us in your recent letter.

Voluntary, whole-hearted co-operation like this assures the success of the exposition, which incidentally is moving along in good shape.

As you know, the International Ampitheater was selected as the site for the exposition after all facilities in Chicago were carefully inspected. The Stockyards Inn is adjacent to the Ampitheater; the Inn is a hotel and the exhibitors will be able to get accommodations there. We will also be permitted to use the meeting and dining rooms of the famous Saddle and Sirloin Club.

Again, thank you for your helpful comments.

Sincerely,
Clyde Kelly *Chairman*
1952 Industrial
Finishing Exposition

News from California

By Fred A. Herr

The $140,000,000 chemical plant in the Nevada desert between Las Vegas and Boulder Dam is being resuscitated as a producer of various types of chemicals.

The plant has had a unique history. It was built by the government in 1942 and within two years produced a fourth of all the magnesium used for incendiary bomb and other war purposes. At its height some 14,000 persons were employed there. The boom burst in 1944 when over-production of magnesium caused it to be shut-down.

Efforts of the War Assets Administration to dispose of the huge plant in whole or in part failed during the next four years. In 1948 the State of Nevada acted to save the 140 million dollar industrial giant. The State bought the establishment from the Federal government for an initial payment of one dollar and a payment of

$24,000,000 in 20 years out of profits.

Much has been accomplished since the State placed Robert J. Moore, former Field Artillery colonel, in charge. Many of the factory structures have been leased to private concerns. Among these are the Western Electrochemical Company, which is currently producing potassium perchloride; and Stauffer Chemical Company, which is manufacturing caustic soda, hydrogen, chlorine and other chemicals.

Another section of the magnesium plant has been leased by the Titanium Metals Corporation, subsidiary of National Lead Company and Allegheny Ludlow Steel Company. Titanium Metals has already tooled up (mid-October) and was at that time nearly ready for production of titanium. The firm has arranged for an annual production rate of about 3,800 tons. Facilities have been installed for refining titanium from rutile, a tintanium-bearing sand obtained from Florida and Australia.

Indicative of the membership spread of Los Angeles Branch of the A.E.S. in the Southern California area, was the attendance at a recent branch meeting at which members from Los Angeles and 14 adjacent cities were present. These included Leo Antimion and Richard Wooley, Inglewood; Myron Orbaugh, Burbank; Gilbert Extale, Ontario; E. G. Richardson, Long Beach; D. W. Eldred, San Marino; W. A. Felker, Torrance; Ray Bray, Pasadena; Glenn A. Hall, Inyokern; Ernest Hamor, South Gate; Leon Kadison, Culver City; Harry Meagher, Norwalk; Alex Regmunt, Bell; and Charles Wirth, Newport Beach; plus some four dozen from Los Angeles.

E. W. Wells of the Chas. F. L'Hommedieu & Sons Company, Los Angeles staff, reported on October 10 that Clarence E. Thornton, West Coast manager for the company, is showing marked improvement in his convalescence from the severe illness which has kept him on the sidelines for several months.

James Poulson, representative of the J. B. Ford Division of Wyandotte Chemicals Corp., Milwaukee, Wis., was a visitor to Los Angeles in the early part of October. He was revisiting old scenes, for he formerly served as Wyandotte's Southern California representative, a post now occupied by Bud Fernholz.

Discussion of metal finishing, metal powder tool repair and various phases of metallurgy as applied to automotive & aviation engineering were on the agenda of the Society of Automotive Engineers which held a National Aeronautic technical session at Hotel Biltmore, Los Angeles, on October 3. Nine panels of engineering experts discussed the effect of electronics on production, new machining technique, special equipment, tooling development, protective coatings and other topics connected with the job of keeping war planes rolling off the assembly lines.

Metallon Products Company, Inc., Los Angeles, is reported now to be the world's largest producer of iron pipe and tube size flanges. A. J. Beckwith, general manager, estimates that the company ships approximately 15 million flanges east of the Mississippi River per year.

Metallon Products is equipped to handle operations from stamping out the flanges from coils of cold roll steel, to the finishing with a mirror bright finish. The firm polishes on stainless steel only.

Harvey Machine Company has installed a third vertical heat treatment unit in the aluminum extrusion division of its Torrance, Calif., plant. Fa-

cilities now in place make Harvey one of the largest independent operators for heat treating high strength extruded material.

Standard Oil Company of California has announced plans for construction of a $1\frac{1}{2}$ million dollar plant at Richmond, Calif., for manufacture of synthetic detergent material. The new plant will be built for use by Standard's subsidiary, Oronite Chemical Company.

C&W Metal Finishing Company of Montebello, Calif., is constructing a new plating plant to provide enlarged facilities for its electroplating, polishing and finishing operations.

Neomatic, Inc., has moved into larger quarters at 11632 San Vicente Blvd., Los Angeles, where increased facilities are reported to be available for the production and finishing of military aircraft relays, radar and telemetering devices.

Bendix Aviation Corporation announces appointment of R. M. Combes as chief engineer of its Pacific Division in Burbank, Calif. He will supervise the Bendix plant No. 3 in Burbank, including the general laboratories located there.

Bardwell & McAlister, Inc., Hollywood, Calif., reports the election of William Avila, former production head, to the post of vice-president and plant manager. Holder of engineering degrees from the University of Southern California, University of California, Princton and Massachusetts Institute of Technology, Avila formerly was with the atomic energy commission.

American Cyanimid Company announces the appointment of Shelon T. Dahl as West Coast manager of its industrial chemicals and plastic-resins division in Los Angeles. He has direction over the combined sales and production activities of the two divisions.

Carlson & Sullivan, Inc., 1714 California Street, Monrovia, Calif., has announced construction of a new factory near its present plant for use in manufacturing steel tape rules.

Among West Coast industry authorities recently named to the National Production Authority's various industry advisory committees are the following: Aluminum rivets, E. J. Stau, general manager, Cherry Rivet Co., Los Angeles, and Lee B. Doddridge, president, Rivco, Inc., Downey, Calif., Brass mill products; Walter Schroeder, vice-president, Pacific Metals Co., Ltd., San Francisco; and tin products, Roger H. Cutting, president, Northwest Lead Co., Seattle, Wash. Serving on the plating industry advisory board is E. T. Brown of the Cadmium & Nickel Plating Co., Los Angeles, who has already sat in on a number of conferences in Washington, D. C.

Business Items

Veteran MacDermid Salesman, Tom Barron, Retires

Thomas F. Barron, veteran MacDermid Inc., salesman for the Providence territory, retired October 1st, after almost 55 years of active service in the Metal Finishing Business.

Tom will be 71 on November 6, 1951. He started working at the age of 16 for the J. P. Bonett Co. of North Attleboro, Mass. as a scratch brush operator. After several different jobs in the jewelry industry he became Superintendent of an Attleboro jewelry plant until it was forced to close due to the first World War.

In 1917 Tom started selling chemicals to the Metal Finishing Industry, and, except for a brief venture into the manufacturing of metal pencils, has been active as a salesman.

Tom F. Barron

Tom started working for *Hanson-Van Winkle* in 1922 until they discontinued their Providence warehouse. Geo. L. Claftin Co. took over distributorship for Hanson, and Tom joined that organization.

February of 1932 Tom started with MacDermid, Inc., of Waterbury, Conn. and has been with them until his retirement in October of 1951.

Tom has consistently exceeded his sales quota each year. He has installed 96 Bright Nickel and Bright Copper solutions in the Providence area. The compulsory retirement age is 65 at MacDermid Incorporated; however, due to Tom's excellent health this was extended to age 70.

During the Annual MacDermid Sales Meeting, Tom was honored at a banquet attended by the entire organization, and presented with a matched set of luggage.

His many friends in the Industry join those at MacDermid in wishing him health and happiness in his retirement.

New Export Firm Organized for Behr-Manning Products

The formation of a new company, to be known as *Norton Behr-Manning Overseas, Inc.*, was announced recently by *Norton Co.*, of Worcester, Mass. and *Behr-Manning Corp.*, of Troy, N. Y. The new company will handle all of the export business and direct the subsidiary plant operations of these two corporations throughout the world. Headquarters will be in Worcester with branch offices located in New Rochelle, N. Y. and New York City.

Norton Behr-Manning Overseas, Inc., will handle the exportation of all Behr-Manning and Norton products and will supervise and direct the operations of subsidiary manufacturing plants of both Norton and Behr-Manning companies located in Australia, Canada, England, France, Germany, Italy and South Africa.

The directors of this new company, who are also directors of Norton Company or Behr-Manning Corporation include: *Milton P. Higgins, Ralph F. Gow, Herbert A. Stanton, Elmer C. Schacht, A. Donald Kelso*, and *Henry M. Elliott.*

Officers of the company are: President, *Herbert A. Stanton;* Executive Vice-President & General Manager, *A. Donald Kelso;* Vice-Presidents, *Philip N. Cooke, Paul A. Krumdieck, Frank M. Ryan, Jules A. Schaetzel* and *Henry J. Sheehan;* Treasurer, *William J. Magee;* Assistant Treasurer, *Joseph P. Morano;* and Secretary, *Curtis M. Clark.*

Lea to Market Clair Finishing Machines

The Lea Manufacturing Co., Waterbury, Conn., manufacturer of an extensive line of finishing compositions and equipment, announces a selling agreement with the *Clair Manufacturing Co.*, Olean, N. Y., whereby Lea will handle the sale of Clair specially designed polishing machinery to plating and finishing plants throughout most of the country. This machinery is used for special polishing and glazing operations.

American Hard Rubber Co. Moves Executive Offices

On October 1, the offices of the

American Hard Rubber Co., formerly located at 11 Mercer St., N. Y. C. for 72 years, were moved to a new location at *93 Worth St.*, at the corner of Broadway. This firm is celebrating the 100th anniversary of its founding this year.

Lasalco Announces Top-Level Executive Changes

In August, *Mr. Burton G. Daw* became Chairman of the Board of *Lasalco, Inc.*, and *Mr. Herman J. Struckhoff* became its President.

Mr. Daw has been with Lasalco since June 6, 1927. He came to Lasalco as a salesman, having previously sold plating equipment and supplies for *Hanson - Van Winkle - Munning Co.* After working as a salesman for sometime, he became Sales Manager, and then Vice-President. In November of 1938, he became President, which position he has held until August 29, of this year. Mr. Daw is continuing with the company as a Sales Engineer, and in an advisory capacity.

Mr. Herman J. Struckhoff came with Lasalco in March, 1930, working as a draftsman, engineer, salesman until 1943, when he became Vice-President and Sales Manager, which position he has held until now. Mr. Struckhoff has assumed active management of the company and still is Sales Manager.

Mr. Robert W. Bignall, who has been with the company since 1945, and who has been active in various positions in their office since, has succeeded Mr. Struckhoff as Vice-President.

Harry Allen Joins H-VW-M Co.

Harry F. Allen

Harry F. Allen has joined the sales force of *Hanson-Van Winkle-Munning Co., Matawan, N. J.* Mr. Allen attended the University of California, majoring in chemistry and mathematics. His education was interrupted by service, for over two years, with the United States Army, after which he attended the University of Washington, graduating with the degree of B.S. in Chemistry. His experience includes work with the National Cash Register Co. as a chemist in the plating laboratory. Mr. Allen will make his headquarters in Cleveland, Ohio.

American Smelting and Refining Company New Research Laboratory

Ground was broken in South Plainfield, N. J., on Thursday, October 4, for a new building to house the Central Research Laboratory of the *American Smelting and Refining Company*. Ceremonies at the site, at the corner of Park Avenue and Oaktree Road, were attended by Mayor *Peter Kaymowics*, members of the South Plainfield Council, and many other distinguished guests.

The red-brick building, which will be E-shaped and situated on a 26-acre landscaped plot, will provide 82,000 square feet of floor space, almost twice the space now occupied by the Laboratory at the Company's Perth Amboy Plant at Barber, N. J. It will be erected by Brown & Matthews, Inc., engineers—constructors, of New York, and will be completed and occupied within a year.

The American Smelting and Refining Company (ASARCO), with main

offices at 120 Broadway, N. Y., was organized on April 4, 1899, under the laws of New Jersey to own and manage the properties of 17 corporations and one partnership. It now operates mines, smelting plants, refineries and associated properties in the United States, Newfoundland, Canada, Mexico, Nicaragua, Bolivia, Peru, Australia, Saudi Arabia and the Gold Coast Colony in Africa.

Glyco Appoints Dollinger Sales Manager

The appointment of *Jack H. Dollinger* as Sales Manager has recently been announced by the *Glyco Products Co., Inc.*, Brooklyn, N. Y.

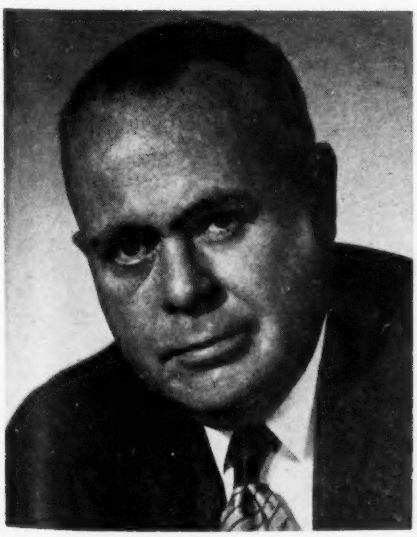
He has been acting as assistant sales manager and technical assistant to the executive vice-president since 1946. Prior to this he was associated with the research and development laboratories of the company. He is a fellow of the American Institute of Chemists and a member of the American Chemical Society.

Battelle Names Jackson Asst. Director

Lloyd R. Jackson has been named an assistant director of *Battelle Institute, Columbus, Ohio*, according to an announcement by *Director Clyde Williams*. He will handle research coordination.

The new assistant directorship, results from the increasing demand by industry and government for Battelle research. Dollar volume in 1951 will exceed nine million dollars, compared with last year's six and three-quarter millions.

Mr. Jackson is known particularly for his work on the engineering properties of materials. He has been associated with much of Batelle's research on fatigue, creep, plastic flow, and is author or co-author of more than 40 technical papers.



Lloyd R. Jackson

Boyd Wins 1951 Southern Chemist Award

Dr. George E. Boyd, associate director of the chemical division at Oak Ridge National Laboratory, Oak Ridge, Tenn., has won the 1951 Southern Chemist Award, it was announced here tonight by *Dr. Frank A. Anderson*, chairman of the American Chemical Society's Memphis Section, which sponsors the Award.

The gold medal was presented to Dr. Boyd at the general meeting of the Southwide Chemical Conference. The presentation was made by *Dr. Anderson*, who is head of the department of chemistry and chemical engineering in the University of Mississippi. *Dr. Henry Eyring*, dean of the graduate school in the University of Utah, gave the main address.

Dr. Boyd was cited for his contributions to the atomic energy program, specifically in the development of chemical separation techniques.

The Southern Chemist Award is given annually to recognize and honor distinguished service to the profession of chemistry in the southern states and to focus national attention upon the scientific progress of the South.

Cowles Adds New Sales Territory

Don Weaver

Cowles Chemical Co. announces the appointment of *Don E. Weaver* as Cowles Technical Man in their Metal Cleaner Department for the Indiana-Southern Ohio territory. This appointment is part of Cowles' expansion program to cover more completely the metal cleaning market.

Mr. Weaver is well qualified to give valuable assistance to members of the metal working industry. He attended Ohio State University and the University of Cincinnati before entering production work and enamel and pickle control work for a stove manufacturer in Ohio. Just previous to coming with Cowles, Don was employed by a large stove manufacturer in the state of New York in a supervisory capacity for metal cleaning preparatory to porcelain enameling.

Creep Characteristics of Platinum Metals

R. H. Atkinson and *D. E. Furman* presented a technical paper entitled "Creep Characteristics of Some Platinum Metals at 138°F." before the Annual Fall Meeting of the American Institute of Mining and Metallurgical Engineers, at Detroit, Mich.

The speakers pointed out that the increasing use of platinum at high temperatures has demonstrated the need for reliable creep data for the guidance of engineers, especially those engaged in designing specialized chemical plant equipment. In order to supply this need, creep tests were conducted at 1,382°F. on 0.290 in. diameter specimens of platinum, 90 per cent platinum, 10 per cent cent rho-

dium and palladium. They described the procedure of these tests and summarized the results.

Mr. Atkinson heads the Platinum Metals Section of *International Nickel's Bayonne Research Laboratory* while Mr. Furman specializes in stainless and heat-resisting alloys at the same laboratory.

Pangborn Has Open House

The Pangborn Corporation, Hagerstown, Maryland, manufacturer of blast cleaning and dust control equipment, has had its first full scale Open House during which all operating and administrative departments were in full operation.

Primarily initiated to permit the wives and families of employees to see how the breadwinner spends his day, and to learn about what the firm makes, the open house also enabled citizens of the nearby area to come in, look around, and learn about one of the largest industrial enterprises in the area.

Special buses carried visitors from downtown points to the plant from 10:00 A.M. until closing. At the plant, specially trained guides took groups through the entire plant where they saw not only the fabrication of blast cleaning and dust control equipment but also visited engineering, accounting, sales, and other "white collar" areas.

To demonstrate how Pangborn blast cleaning and dust control equipment operates, a new Demonstration Room was in full operation.

The reason for the room is to enable potential users of blast cleaning and dust control equipment to send or bring samples of work to Hagerstown and have it processed by Pangborn machines. In this manner they can

determine which is the best piece of equipment to fit their needs. Also, an operating display of this type shows design, production, and plant engineers how this equipment can physically be fitted into their specific process.

Buckeye Products Appoints Bob Fernekes in Western Michigan

The Buckeye Products Company, Cincinnati, announces the appointment of *C. M. (Bob) Fernekes*, 125 Rexford Drive, East Grand Rapids, as its representative in Western Michigan. Long a fixture in the Michigan territory, Mr. Fernekes will handle the complete line of *Speedie* Buffing & Polishing Compositions on a line extending South from Petosky through Lansing and Jackson to the Indiana border, and westward to Lake Michigan.

Cone-Loc Drum Sanders Handled by Carborundum Distributors

Cone-Loc Drum Sanders are now being sold exclusively through The Carborundum Company and the distributors of Carborundum coated abrasives, according to announcement from *American Diamond Saw Sales*, Portland, Oregon, producers of the industrial tool.

This distribution system was set up by *The Carborundum Company* and *American Diamond Saw Sales* in order to provide broad availability of this tool for industry. The experience of Carborundum field personnel will be available to all prospective users.

The Cone-Loc Drum Sander is a cushion-type split drum which makes it possible to use coated abrasives in low-cost strip form.

Additional information may be obtained by writing the nearest district sales office of the Carborundum Company.

British Electrodepositors' Technical Society Now Incorporated

The Council of the Electrodepositors' Technical Society announces that the Society is now an Incorporated Body.

A new title embracing metal finishing generally (excluding only vitreous enamelling) has been adopted. This is in accordance with the general policy of the Society to extend its field beyond electrodeposition processes to include metal finishing generally with which the bulk of its members are vitally concerned.

The new title by which the Society will henceforth be known is *The Institute of Metal Finishing incorporating Electrodepositors' Technical Society Limited.*

As a result of this change the original aims and objects of the Society—namely, to promote the study of, and disseminate information on, electrodeposition and cognate processes as widely as possible—are in no way affected and will, in fact, be pursued as vigorously as ever. The sphere of interest has now been significantly widened and the Council is of the opinion that this will bring with it corresponding benefit to the membership.

The Executive Officers and Council of the new Institute remain unchanged. The present Executive Officers are *Mr. H. Silman, B.S.c., F.R.I.C., A.M.I. Chem. E., F.I.M.*, President, *Dr. S. Wernick, M.Sc., F.R.I.C., F.I.M.*, Honorary Secretary, and *Mr. F. L. James*, Honorary Treasurer.

Turco Names Beard and Glavin to New Positions

Appointment of *Archie K. Beard* as midwest sales manager of *Turco Products, Inc.*, was announced recently by Pres. *S. G. Thornbury. Harold P. Glavin* has been named to the post of general manager, midwest division factory, with headquarters in Rockdale, Illinois.

The newly-acquired modern Rockdale factory, completely equipped with brand new manufacturing equipment, will be geared to produce both powder and liquid industrial chemical compounds for Turco's midwest sales area.

Beard, formerly Turco's district manager in Cleveland, has been transferred to Chicago. He will be in charge of sales for the Midwest area.

Glavin, for the past year office manager of Los Angeles Business Office, will coordinate factory and office operations in the Midwest Division. He joined the accounts payable department in January, 1947, and since that time has worked his way up through the organization's ranks.

G.E. Announces Six New Operating Divisions

The formation of six new operating divisions has been announced by the G.E. Co.

Together with the recently-announced defense products division, the six new divisions include the majority of the departments which consti-

COMING EVENTS OF THE A. E. S.

Philadelphia Branch
Annual Educational Session and Banquet
November 17
Broadwood Hotel — Philadelphia, Pa.

Detroit Branch
Annual Educational Session and Banquet
November 30 - December 1
Statler Hotel — Detroit, Mich.

Newark Branch
Educational Session - December 14
Christmas Party - December 15
Hotel Robert Treat — Newark, N. J.

New York Branch
Annual Educational Session and Banquet
February 16
Statler Hotel — New York, N. Y.

tuted the former large apparatus division and small apparatus division.

Henry V. Erben, executive vice-president in charge of the apparatus group, announced the following appointments: *Glenn B. Warren*, of Schenectady, as general manager of the turbine division.

James M. Crawford, of Pittsfield, now general manager of the motor and generator division; *Francis E. Fairman, Jr.*, of Schenectady, general manager of the transformer and allied products division.

George E. Burens, of Baltimore, general manager of the switchgear and control division.

Robert Paxton, executive vice-president in charge of the industrial products and lamp group, announced the appointment of Harold E. Strang, as general manager of the measurements and industrial products division, and *William C. Wichman*, general manager of the component products division.

Union Carbide and Carbon Announces Appointment

Adger S. Johnson

Adger S. Johnson has been appointed President of *National Carbon Co.*, a division of *Union Carbide and Carbon Corp.*, according to an announcement made today by *J. M. Spangler*, National Carbon's Chairman. Mr. Johnson has been vice-president and general manager since May, 1950.

He was born in Charleston, South Carolina, and grew up in Blacksburg, Virginia. Here he also attended Virginia Polytechnic Institute, which awarded him a degree in Chemical Engineering in 1928. Upon graduation he entered the employ of the above firm and in 1933 was assigned to the Eveready battery plant in Shanghai.

China. By 1939 he had become superintendent of this plant.

In the latter year he was recalled to the U. S., where he served as Superintendent at several company plants. In 1944 he was made Assistant to the vice-president in charge of production. Four years later Mr. Johnson became vice-president in charge of foreign plants, and in 1950 he was appointed vice-president and general manager.

Power Shortages Hit Aluminum Production

The United States primary aluminum industry continued its production rise during August, *Donald M. White*, secretary of *The Aluminum Association*, reported recently, although power shortages in the Pacific Northwest have since forced curtailment.

Primary output for August reached the high level of 147,630,992 pounds, exceeding the July figure of 145,395,271 pounds by more than two million pounds. As secretary of the Association representing all primary producers of the metal and about 85 per cent of all semi-fabricated aluminum products in the country, he said that continued production advances could be expected if sufficient power to produce the metal were available at all times. July and August increases resulted from expansion and reactivation programs within the industry which eventually will increase its annual capacity by more than a billion pounds.

Aluminum sheet and plate shipped by member companies of the Association's Sheet Division totalled 91,888,728 pounds during August, a decrease of 1,882,350 pounds from the 93,771,078 pounds shipped in July.

A gain of nearly a million pounds was recorded by the Association's Foil Division for the month of August—7,877,325 pounds, compared with 6,918,091 pounds shipped in July.

Shipments of permanent-mold and semi-permanent-mold rough castings (except pistons) by Foundry Division members increased considerably over July. In August a total of 2,596,489 pounds were shipped, with a value of $1,512,423, as against 1,816,894 pounds and a value of $1,069,456 for the preceding month.

Bart-Messing Enlarges Belleville Plant

To insure prompt delivery for the increasing demand for SEL-REX Selenium Rectifiers, *Bart-Messing Corpo-*

ration has enlarged its manufacturing facilities. International distribution and exclusive developments have been prime factors in the heavy demand. The new area will provide for more assembling and testing space.

Convention will Emphasize Wage Stabilization

An entire evening session of the forthcoming Convention of the National Metal Trades Association will be devoted to a panel discussion of "Wage and Salary Stabilization."

Moderator of the session will be *Earle S. Day*, vice-president and general manager, *Collyer Insulated Wire Co.*, Pawtucket, R. I.

Members of the panel are: *Nathan P. Feinsinger*, Chairman, Wage Stabilization Board, Washington, D. C.; *Hiram S. Hall*, Industry Member, Wage Stabilization Board, Washington, D. C.; and *Joseph D. Cooper*, Executive Directory, Salary Stabilization Board, Washington, D. C.

Du Pont Collects 50 Million Pounds of Scrap

Enough iron and steel scrap to make the steel for 2,100 light tanks, was shipped to the nation's steel mills by *Du Pont Company* plants from May 1st through August. By means of a long-established salvage and reclamation program, Du Pont collected 50 million pounds of scrap iron and steel in response to the National Production Authority's plea early in May for the scrap metal. Salvage of scrap is continuing through an intensive company-wide drive.

Non-production iron and steel scrap in the amount of 22 million pounds was shipped to the steel mills. Iron-bearing sludge, channeled to the same outlets, accounted for another 28 million pounds. During the same period, 37,000 usable pieces of equipment and machinery were delivered both to outside users and to company operations, making it unnecessary to order

new equipment for those tasks.

Their salvage program, begun in 1907, is expected to yield an all-time high tonnage this year. During the four-month period in which 25,000 tons of iron and steel scrap were collected, the following amounts of critical non-ferrous metal scrap were salvaged: lead, 1,600,000 lbs; copper, 1,010,000 lbs.; aluminum, 150,000 lbs.; zinc, 25,000 lbs.; nickel, 20,000 lbs.

The company, which has long recognized that good plant "housekeeping" goes hand in hand with good salvage operations, has also collected since the start of the stepped-up national campaign hundreds of tons of such materials as paper, chemicals, greases, solvents, containers, pipe, valves, electrical and mill supplies, and lumber. Also reclaimed are small items such as workers' gloves and goggles and hand tools. This material is re-used on Du Pont plants and on defense projects outside the company.

Salvage activities in Du Pont are co-ordinated by the salvage and reclamation organization of the Office Buildings Department. This group disposes of the excess materials from all company plants.

OBITUARIES

ADOLPH BREGMAN

It is with deepest regret that we report the death, on October 4, 1951 of Mr. Adolph Bregman, well known consultant on metal finishing operations. His death was attributed to a heart attack. He was 61 years old.

Mr. Bregman was a graduate of the Colorado School of Mines, class of 1914. His early experience was gained in the mining and smelting industry, and in 1919 he joined "Metal Industry," predecessor to "Metal Finishing" as managing editor, a position he held until 1938. He left Metal Finishing to establish a private consulting practice, and in recent years he was a consultant for the Hanson-Van Winkle-Munning Co. He was also an associate editor for Metal Progress.

His interests were wide and varied, as witnessed by the fact that he was co-author of a musical book "*Songs of American Folks.*"

Perhaps Mr. Bregman's' most important work was on behalf of the job plating industry in and around New York. He was an organizer of the Masters Electroplating Association, and had headed that group for a number of years in all its affairs.

He was also active in the affairs of the national job platers organization, the National Association of Metal Finishers.

Through his efforts a number of successful business and technical practices were instituted which materially aided New York job platers, and his wealth of knowledge and willing co-operation will be sorely missed.

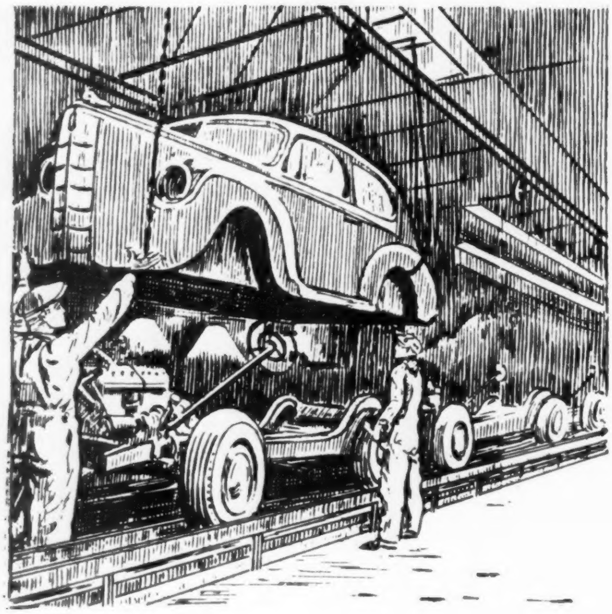
He is survived by his widow, two daughters, two brothers, and a sister.

JOHN L. DeVRIES

After an illness of several months, John L. DeVries, a member of the Newark Branch, died at the age of 51. Mr. DeVries was a graduate of Rutgers Univ., class of 1921. He was the New Jersey representative for Oakite Products, Inc., having joined that firm in 1935.

Mr. DeVries was a past president of the Newark Branch, and was active in all its affairs.

He is survived by his widow, a son, his mother, and one brother.



MOTOR CITY PLATING NEWS

by

Edward Finne

Detroit Cad and Zinc Corp. have opened their doors for business at 11555 East Warren, Detroit.

The firm is working as job platers in cadmium and zinc and they have equipped their 8,000 square foot building with a semi-automatic cadmium set-up, a full automatic zinc machine, a barrel cadmium line, and a zinc barrel line.

The corporation officers are:
Ed Torosian, President.
Milton Pitts, Vice-President.
William Murray, Secretary.

Tom Cusumano is the plant superintendent in charge of production.

The company will have its own control laboratory for complete solu-

tion analysis and it will also have its own salt spray test facilities.

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Bill Andrews and *Tom Tinsdale*, former owners of the *Famous Electroplating Co.*, have purchased the Mercury Plating Co. and renamed it *Mutual Plating Co., Inc.* The plant is located at 25611 West Eight Mile Rd., Detroit.

Their bright plating operations have been augmented by the addition of a 6,000 square foot plating area to the older building and they are setting up equipment for still zinc and barrel cadmium and zinc plating.

****

Micro Hard Chrome Platers, 317 E. Milwaukee, Detroit have recently opened in a 5,000 square foot 2-story building.

Roy Hicks and *Paul Thompson* are the active partners and the firm is equipped to perform hard chrome plating, copper-chrome decorative plating, and polishing and buffing.

****

Opening its fall and winter season, the Detroit branch of the A.E.S. met at the Statler Hotel on Friday, Sept. 7th.

Twelve new members were elected to membership in the society.

Following a movie, "*Texas Quail*," the members heard from a group of job platers.

Ray Shock, national secretary of the Plating Institute and National Association of Metal Finishers, gave his interpretation of government regulations on plating.

Bob Huber, Michigan Chrome & Chemical Co., and a member of the Advisory Committee for Job Platers for NPA reported on the progress being made by the committee.

Gerald Burgess of Electroplating Service drew a picture of the job platers in this trying period.

Webb Knight, Knight Plating Co., spoke on substitute plates for nickel-chrome and he reports that best results are being had with the new white brass process.

Refreshments were served following adjournment of the meeting.

****

Modern Hard Chrome Service Co., of 975 E. Vernor have moved to a newly built 9,000 square foot building located at 12880 East Nine Mile Road.

The concern hard chrome plates only and, to this end, they have installed 6,200 gallons of chrome plating solution. They feature one 20 ft. tank complete with overhead cranes to handle very large and heavy parts.

The company's officers are:
Theodore Nicholl, President.
Samuel Nicholl, Vice-President.
Vern Nicholl, Secretary-treasurer.

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The regular monthly meeting of the Michigan chapter of the *Plating Institute* was held at the Detroit Athletic Club on September 12, 1951.

Following dinner, discussion covered the government regulations which have come out of Washington during the previous month.

The meeting was very well attended and a representative from *Anotreat, Inc.*, of Jackson, Mich. was present. Anotreat has applied for membership in the Institute.

Following the regular meeting, officers and members of the board convened for a special meeting.

****

The recent 100th Meeting of the *Electrochemical Society*, held at the Hotel Statler, attracted a record number of registrants. A number of important and novel methods for plating alloys were disclosed at one of the technical sessions. (Abstracts of these papers will, be found in the December issue of *Metal Finishing*). Plant visitations to the Chrysler Engineering Laboratories, Ford Motor Co.'s Monroe plating and waste disposal plant, and to the Dow Chemical Co., in Midland were features of the meeting.

****

Gerity-Michigan Corp., a leader in the plating and finishing industries, and a large manufacturer of gear motors, expects to be in production soon on a contract from the Detroit Ordnance District for hard chrome plating of Army cannon tubes. A $500,-000 addition to the company's Adrian plant to be used for the cannon tube plating operation is now under construction.

Also under construction at the Adrian plant is a new building in which the company will produce sand mold magnesium castings, under a United States Air Forces contract, for supply to various aircraft engine manufacturers. Full capacity of production is contracted for.

The present board of directors of Gerity-Michigan was re-elected at the recent annual meeting.

EXTRACTS OF PLATING LITERATURE

(*Continued from page 76*)

Chromium Plating Anodes

E. R. Thews: *Metalloberflaeche*, vol. 5, No. 6, pp. B-84 - B-86.

The author first discusses the reasons for the present exclusive use of insoluble anodes in chromium plating baths and mentions the difficulties which have rendered it impractical up to now to use soluble chromium anodes. These are the very high degree of solubility of the anodes in the chromium bath and the inability of soluble anodes to convert the trivalent chromium salts to chromic acid.

Measures proposed for the use of soluble chromium anodes embody hanging 10% of the total anode surface as soluble chromium anodes and the remaining 90% as insoluble anodes. This is in conformity with the ratio of the anode to cathode efficiency in the normal chromium electrolytes and in theory would suffice to maintain the bath composition reasonably constant in chromium ions. Alternatively, soluble chromium anodes could be inserted in the bath for definite periods and then removed periodically to give the same effect. These measures are discussed and dismissed as impractical. For one thing, during the bath operation, 100% of the anode surface must act in an oxidizing manner on the trivalent chromium in the bath.

The use of chromium alloy anodes, which has been patented, is also not regarded as practical. Either the alloyed anodes still show too high a solubility or else the bath becomes loaded with too much slime. Further, the necessary oxidation of the trivalent chromium may not be attained and finally these alloyed anodes render the bath operation more expensive than with the normal chromium bath.

As insoluble anodes, lead and lead-antimony alloys are suitable. Steel anodes have been used but have serious technical disadvantages. Firstly, the iron build-up in the bath is troublesome and secondly the oxygen overvoltage at steel anodes is not significant. It is actually too small in order to maintain the auto-oxidation of the cathodically formed trivalent chromium salts to chromic acid in sufficient amount. The favorable ratio between the trivalent chromium salts and the chromic acid in the electrolyte to obtain a satisfactory chromium plate is thus too strongly changed.

As regards whether anodes of soft lead and alloyed antimony lead anodes are better, practice has tended towards the use of the latter. Soft lead anodes are generally used only now for well profiled anodes or as auxiliary anodes. With soft lead anodes it is best to give an anodic oxidation treatment before plating into plating service. However, it is advisable to remove the lead anodes from the chromium bath during nonoperational periods and to spray off any residual electrolyte.

As regards the relative performance behaviors of

soft lead and lead-antimony anodes in the chromium bath, the following can be said:

1. Pure lead anodes are somewhat more resistant in the normal chromium plating baths than antimony-lead anodes with 5-6% antimony; however the actual solubility of the antimony anodes is so slight as to be insignificant.

2. Pure lead anodes are more easily soluble in chromium baths during non-operational periods than lead-antimony anodes.

With fluorine-containing chromium electrolytes, lead-antimony anodes with antimony contents of up to 13% and even up to 25% have given good performance. When the chromium bath works practically uninterrupted it is possible to work with very low antimony contents such as 0.5% sf. Although lead-antimony anodes are not significantly attacked in the chromium bath nevertheless during the course of time an appreciable loss in weight does occur and the fairly hard crust of yellow lead chromate which forms on the anode surface has to be scraped away. This should be done every week. Lifting and spraying the anode surfaces during every operational pause of the bath will serve to double this period when attention is required. The crust may be loosened by treatment with a concentrated aqueous solution of sodium chloride acidified with hydrochloric acid. Careful attention however as mentioned above, to lifting and spraying the anode surfaces every time the bath is not in operation can serve to reduce this crust formation quite appreciably.

As regards the effect of the bath composition on the anode attack, it is a fact that sulfuric acid-containing chromium baths have a much weaker action on hard lead anodes, than fluoride electrolytes. The ratio of the anode to the cathode surface is of technical significance. This governs not only the throwing power and capacity for plating in recesses but also the ratio between the trivalent chromium compounds and the chromic acid content of the electrolyte. If the electrode surface ratios and the other working conditions are favorable so that an optimum anode current density region is maintained, then the most favorable contents of trivalent chromium compounds can be counted on and under normal conditions this will vary between 5 and 12 grms./litre of Cr_2O_3. The re-oxidation of these trivalent salts to chromic acid depends on the anodic current density. This oxidizing effect decreases with increasing anode current density. As the efficiency of the chromium plating process requires definite minimum anode current densities, then an optimum equilibrium must be maintained and this will be determined by a definite anode-cathode ratio. This ratio will vary between 1:1 and 3:1. An average value of anode to cathode area is usually maintained of I.25 - I.75 : I.

Regarding the effect of anode impurities, only zinc and arsenic will be troublesome. This can lead to rough, burnt or dull chromium plate.

Racking Arrangements for Electroplating

O. K. Paemer: *Metalloberflaeche*, vol. 5, No. 6, pp. B-81 - B-83.

The author first discusses the theory of the distribution of the electrolytic lines of force in the plating bath and the edge and corner effect in the bath. The distribution of the current density at the cathode is then considered and the difficulties encountered in connection with the plating of profiled and recessed ware in association with the throwing power characteristics of the bath. Means to rectify irregular plated metal thickness caused by these factors are then considered, such as shaped anodes, suitably designed racking cathode equipment and masking of exposed edges and corners.

Dealing first with nickel plating baths the author mentions the relative simplicity of working with these baths as the throwing power is relatively good. Copper or brass wire hook suspension is generally used for individual large objects; points to watch are that the ware hangs parallel to the anodes and that no shielding occurs with the different parts. Small parts can be either suspended by wire or else preferably, special clasp jigs designed. The advantage of clamp type racking jigs is that uniform contact is provided to each part on the rack and no part can fall into the bath while the rack is being inserted or removed. A design of a racking jig of this type is shown. For larger parts where sufficient contact is given by their own weight, hanging from wire hooks on the rack will generally be sufficient. In the case of pots and pans which are required to be nickel plated both inside and outside, the use of an internal anode becomes necessary.

Special mention is made of the practical difficulties encountered with decorative and hard chrome plating baths. Because of the high current densities employed, it is necessary to ensure that the cross section of the plating racks is sufficiently great. In addition, screening wires will usually be required to ensure that gray burnt edges which are difficult to polish, do not occur. A developed design is presented for the chromium plating of large flat parts; the rack is provided with a circumferential screening wire placed at a distance of 3 to 4 cm. away from the edge of the part so that no burning or graying at the periphery of the article can occur. In the case of small parts the racking arrangements are much the same as for the nickel bath with spring clamp fixtures; the distanct apart however of the parts should be greater here than is necessary with nickel plating so that the same racks as for the nickel bath cannot be used in the chromium bath; special racks must be designed for the chrome bath.

Correct design of the hanging racks is of great importance in the case of hard chrome plating. It is most important here that the hard chrome coating should be as uniform as possible over the whole surface and that the previously determined minimum thickness limit be conformed to. The coating should also be capable of being ground at the edges. With high current densities, on the average of 50 amps./sq. dm., special attention must be given to providing good con-

tact arrangements with the racking equipment. A developed suitable racking design for bolts and shafts is shown diagrammatically. A further racking design is shown for sharply contoured shafts with offset journal bearing surfaces for example is shown in a further diagram. Another diagram shows the design of a racking arrangement for the hard chrome plating of coupling discs for which only the running surfaces are required to be hard chrome plated.

Speaking generally, the racks should be made of round section material. The protection becomes generally damaged after a short time at the sharp edges; also experience has shown that when the racks are lifted from the bath the electrolyte runs off round section rack material quicker than that with sharp edges.

Scale Removal Problems in Pickling Ferrous Metals

G. Rossi-Landi: *La Metallurgie*, vol. 83, No. 5, pp. 389-391.

The nature of scale on ferrous metals is first discussed, the author dealing with Wustite (FeO) which is adherent to the metallic surface and the other type which is on the outer side of the scale layer and consists of Fe_2O_3 and Fe_3O_4. As the pickling acid can pass through this scale layer via cracks and porosities, the metal surface will be vigorously attacked long before the scale layer is dissolved or flaked away, unless an inhibitor is used in the bath. The thickness of the scale layer has relatively little effect on the course of the pickling process. What is important is that the pickling process will be affected by the structure of the scale and by its adherence to the metal. The pickling bath and conditions should be formulated and operated on this principle. A satisfactory pickling must not only remove the scale without appreciably attacking the metal but also perform this duty in an economic manner.

As the actual nature of the scale skin on ferrous metals will vary according to the production conditions of the metal and according as to whether the metal is rolled, drawn or cast, the pickling conditions must be adjusted accordingly for these different types of products. Scale removal by pickling of castings is relatively easy. The oxide skin is either very light and easily removed or else it will be loaded with oxide and be very hard. In the first case a low concentration of pickling acid is required and a minimum pickling temperature. In the second case it is necessary to increase the acid concentration and to raise the pickling temperature.

Scale formed during reheating and heat treatment is composed of a light and porous coating which is quite easily removed with a very low acid concentration.

A bad pickling effect in general can be ascribed to one of the following causes: quality of the acid, concentration of the pickling bath, operating temperature of the pickle bath and duration of the immersion.

PATENTS

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Anodic Treatment for Magnesium

U. S. Patent 2,553,449. *H. M. Freud.*

A process of providing a protective coating upon a metallic article composed substantially entirely of magnesium and magnesium base alloy, by galvanic action, which comprises placing such an article to be protected, as anode in an acid electrolyte having a pH value above 2.5, but not substantially above 3.95, and such electrolyte being incapable of chemically attacking metallic magnesium, and said electrolyte consisting essentially of water containing a soluble manganese compound of chromic acid, said electrolyte also containing a small amount of at least one substance containing the anion of a mineral acid which mineral acid would in higher concentration be capable of chemically attacking magnesium, such acid being selected from the group consisting of sulphuric acid, nitric acid and phosphoric acid, the amount of such mineral acid ion being not more than 0.1% of sulphate ions, not more than 0.5% of nitrate ions, not more than 0.2% of phosphate ions, and placing a cathode in said electrolyte, but out of physical contact with said anode, such cathode being an electrically conductive material more noble than magnesium, electrically connecting said anode and said cathode outside said bath, the electrode potential of the magnesium electrode in said electrolyte relatively to the hydrogen electrode being not over 1.1 volts, continuing the flow of said current until a protective film of substantial thickness has been formed on said anode.

Electropolishing Aluminum

U. S. Patent 2,553,937. *J. Patrie, assignor to Compagnie de Produits Chimiques et Electrometallurgiques Alais.*

In a method for electrolytically polishing and brightening articles consisting at least for the major part of aluminum, the step of effecting the electrolytic polishing and brightening treatment at a temperature below 20° C. in an electrolysis bath containing 30 to 45% by weight of nitric acid and a significant amount of at least one member of the group consisting of phosphoric and chromic acids, the acids arranging between 43 and 79% by weight, the balance being water.

Buff Design

U. S. Patent 2,553,793. *A. B. Stafford, assignor to Ajax Buff Co.*

A buffing wheel comprising a cloth buffer and a pair of clamping members having portions overlying opposed side surfaces of said buffer, one of said members having integrally formed pointed projections extending completely through said buffer into interlocking engagement with the other of said members to secure said buffer in position between said members, said pointed projections thus preventing both radial shifting and axial separation of said members and said buffer.

Phosphate Treatment for Iron and Zinc

U. S. Patent 2,554,139. *R. F. Drysdale, assignor to The Walterisation Co., Ltd.*

A process for the production of corrosion-resistant coatings on a metal

selected from the group which consists of zinc and iron, which comprises treating said metal in an aqueous solution which contains essentially at least one primary orthophosphate of a metal selected from the group which consists of zinc, manganese and iron, there being also present in said aqueous solution at least a very small amount of the cations of at least two metals, neither of said metals being an alkali metal and one of said metals being more basic than the metal being treated, and the other of said metals being less basic than the metal being treated, the total amount of said cations present in said solution ranging from 0.0003 to about 0.04 gram per litre of the said aqueous solution, said cations being present as part of a water-soluble salt of said metals, or as substances which form water-soluble acid phosphates.

Selective Blackening of Aluminum

U. S. Patent 2,554,256. *V. E. Lewis and W. E. Collar, assignors to Westinghouse Electric Corp.*

The process of preferentially coloring selected portions of aluminum members all of whose surfaces have been exposed to air for more than 15 hours, the steps comprising abrading the selected portions to remove a surface layer, and applying to the abraded portions, within 15 hours after abrading and without exposing the abraded surface to temperatures of above 300°C., a hot aqueous, non-alkaline solution composed of from 1 to 120 grams per liter of ammonium molybdate and from 1 to 128 grams per liter of ammonium chloride for from 30 seconds to 10 minutes.

Continuous Plating of Strip

U. S. Patent 2,554,943. *Q. B. Farmer, assignor to Bethlehem Steel Co.*

An apparatus for the continuous electroplating of metallic strip of different widths comprising a tank containing a plurality of vertical anodes aligned in tandem with the main faces of the anodes in parallel relationship, said anodes being fixed against lateral movement and having a width substantially equal to the mean width of the strip to be electroplated and not less than two narrower vertical anodes, one of said narrower anodes being reciprocally laterally adjustable from one side of said tank to a point at which the vertical center line of the anode is in substantial alignment with the vertical center line of the tank and another of said narrower anodes being reciprocally laterally adjustable from the opposite side of said tank to a point at which the vertical center line of the anode is in substantial alignment with the vertical center line of the tank, said narrower anodes having a width less than one-half the width of the fixed anodes, means to reciprocally laterally adjust the narrower anodes and means to move the strip between and past the anodes.

Ultrasonic Polishing

U. S. Patent 2,554,701. *J. C. Hackett and S. H. Johnson, assignors to Doehler-Jarvis Corp.*

The method of polishing an article in successive stages, which includes immersing the article in a liquid having abrasive particles and vibrating the liquid at a first frequency, then

immersing the article in a liquid having abrasive particles and vibrating the liquid at a different frequency.

Chromizing Process

U. S. Patent 2,555,372. *J. H. Ramage, assignor to Westinghouse Electric Corp.*

The method of protecting against oxidation at high temperatures, articles constructed of refractory but readily-oxidizable metals and alloys thereof comprising electroplating them with chromium, covering said plated articles with powdered chromium, and heating in hydrogen at a temperature of about 1100°C., to obtain a firmly-adherent coating of chromium thereon.

Bright Silver-Antimony Alloy Plating

U. S. Patent 2,555,375. *W. P. Ruemmler, assignor to Battelle Development Corp.*

A method of electrodepositing a bright silver-antimony plate upon a metal article, which comprises immersing the article to be plated in an aqueous electrolyte consisting essentially of from 20 to 150 grams per liter of silver cyanide, from 20 to 100 grams per liter of a cyanide selected from the group consisting of potassium, sodium, and ammonium cyanides, from 10 to 300 grams per liter of a tartrate selected from the group consisting of potassium, sodium, and ammonium tartrates, from 2 to 8 grams per liter of a hydroxide selected from the group consisting of potassium, sodium, and ammonium hydroxides, from 5 to 40 grams per liter of a carbonate selected from the group consisting of potassium, sodium, and ammonium carbonates, and from 3 to 100 grams per liter of an antimonyl tartrate selected from the group consisting of potassium, sodium, and ammonium antimonyl tartrates, passing an electric current through the electrolyte in such a manner that the article becomes a cathode, regulating the electric current to provide a current density of from 5 to 90 amperes per square foot, maintaining the pH in the electrolyte of 11.0 to 13.5 by proper adjustment of said ingredients added to the bath, and heating the electrolyte to a temperature between 70°F. and 140°F.

Reverse Current Cleaning of Strip Metals

U. S. Patent 2,556,017. *E. E. Vonada.*

3. The method of continuously cleaning strip electrolytically which comprises passing the strip between a pair of anodic electrodes, passing the strip between a pair of cathodic electrodes, and periodically reversing the polarity of the electrodes.

Buff Design

U. S. Patent 2,556,044. *E. Sandman and E. R. Sykes, assignors to Eli Sandman Co.*

1. A buff comprising a center hub, a plurality of wraps of pre-pleated material wound around the hub circumferentially thereof, the hub being at the center of the wrapped material, a band encompassing the wraps centrally thereof, and of the hub circumferentially of the latter, said band tightly pressing the pre-pleated material to the periphery of the hub, the wraps of material being folded over

the band and extending radially outwardly from and in plane with the hub.

Etching Aluminum

U. S. Patent 2,556,626. *C. E. Meulendyke.*

In the arts of metal-decoration and photomechanical printing, the method of etching aluminum by applying a solution containing cupric chloride, glycerine and orthophosphoric acid to an aluminum sheet supporting local resists.

Auxiliary Anode Design

U. S. Patent 2,557,503. *G. B. Hogaboom, Jr.*

1. An electroplating anode structure for stationary axial opposition to a disc-shaped cathode in a plating tank comprising a hollow conical frame body of electrically conductive metal which is substantially insoluble in the plating solution to be used, said body having an opening at its apical portion leading out of its interior, said body, being further provided in its sides with circumferentially spaced slots radial to its apical portion to lead into the interior of the body, externally projecting deflector baffles bordering sides of the slots to divert flow of plating solution through the slots into the interior of the body for discharge through said apical opening of the latter toward the work, soluble plating anode members and means on the body supporting the plating anode members upon the external surface of the body intermediate the slots thereof.

Chromate Treatment for Zinc and Cadmium

U. S. Patent 2,559,878. *D. M. Johnson, assignor to Western Electric Co.*

The method of passivating zinc and cadmium surfaces of parts which consists in dipping the parts in a solution of a trivalent salt of chromium selected from the group consisting of chrome alum and chromic sulphate, and nitric acid in water, wherein the salt of chromium constitutes approximately one ounce for each gallon of water, and the nitric acid constitutes from .1% to .75% by volume of the solution, and holding the parts in the solution for from 5 to 20 seconds while maintaining the solution at from 50°F. to 130°F.

Corrosion-Resistant Treatment for Steel

U. S. Patent 2,557,509. *D. E. Miller, assignor to Kelite Products, Inc.*

A process of protecting a ferrous metal surface from rusting which process comprises treating the surface to be protected with an aqueous solution the solute of which essentially consists of molybdenum trioxide and sodium acid sulfate, the solution containing from 0.03% to 1% of molybdic acid and having sufficient sodium acid sulfate to provide a pH of from 2.0 to 4.0.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Pittsburgh Branch

The Pittsburgh Branch of the A.E.S. held its second meeting of the year,

October 11, at the Sheraton Hotel. Twenty-five members were present at the dinner and approximately forty-five attended the business session. We were very pleased to have an exceptional number of guests present; we felt that this was quite an honor both to the Branch and to the speaker of the evening. The guests were: *J. F. Whitehead*, Westinghouse; *Wm. H. Wooster*, National Casket Co.; *Irvin M. Weiss*, United Chromium, Inc.; *Bob Preston*, Johns-Manville; *Al Pope*, Penna. Salt Mfg.; *M. S. Patterson*, American Chemical Paint Co.; *Russ McCorkle*, Collins & Wright; *J. M. Lloyd*, Flannery Mfg. Co.; *Joseph Lupnacca*, Spang-Chalfant; *W. A. Helbig*, Darco; *Bill Gordon*, MacDermid and Western; and *William Fargo*, L. D. Cochran. *Bill Hennessy*, one of our past presidents and most active members, recently transferred to Philadelphia, was present. The various branch officers and committee chairmen gave their reports. From all indications, our December "Milwaukee Night" is going to be a 'bang-up' affair. The plans for our Annual Banquet are also well along the way even though the event is in the distant future. Since there was no pressing new business *Bob Varner*, our librarian, introduced the speaker of the evening, *Mr. W. A. Helbig*, Chemical Engineer, Darco Corp. Mr. Helbig's subject was "Purification of Electroplating Solutions by Filtration and Activated Carbon Treatment." A few of the topics which he discussed were:

1) General Principles of Filter Operation
2) Solids Capacity of a Filter
3) Effective Filter Area
4) Solids Capacity vs. Effective Filter Area
5) Recirculation and Precoating
6) Measuring Filtration Rate
7) Regulation of Pressure and Flow Rate
8) Periodic Treatment with Activated Carbon
9) Continuous Treatment with Activated Carbon

The lengthy question period which followed the main lecture was concrete evidence of the interesting and informative nature of Mr. Helbig's discussion. The meeting was brought to a close by *Rex Goldbach* after we all gave our speaker a rising vote of applause.

Detroit Branch Annual Educational Session

The Detroit Branch of the A.E.S. announces its annual meeting and benquet which will be held at the Hotel Statler in Detroit on November 30 and December 1.

The annual educational session will occur on Friday evening, November 30. Recognizing the increased importance of copper plating, stemming from the acute nickel shortage, the educational session will consist of a symposium on modern methods for the electrodeposition of copper. The cyanide, acid and pyrophosphate baths will be discussed, with special emphasis on variations of these processes to achieve smooth, dense, lustrous deposits.

The program is as follows:

The Cyanide Bath — *Dr. A. K. Graham.*

PR Application to the Cyanide Bath —*Mr. B. C. Case.*

The Pyrophosphate Bath — *Dr. Jesse Stareck.*

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946, of METAL FINISHING, published monthly at New York, N. Y., for Oct. 1, 1951.

State of New York, County of New York, } ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Thomas A. Trumbour, who, having been duly sworn according to law, depcses and says that he is the General Manager of METAL FINISHING and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily, weekly, semiweekly or triweekly newspaper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations), printed on the reverse side of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Finishing Publications, Inc., 11 West 42nd St., N. Y. 18, N. Y. Editor, L. H. Langdon, 11 W. 42nd St., N. Y. 18, N. Y. Managing Editor, None. Business Manager, Thomas A. Trumbour, 11 W. 42nd St., N. Y. 18, N. Y.

2. That the owner is: Finishing Publications, Inc., 11 W. 42nd St., N. Y. 18, N. Y. L. H. Langdon, 11 W. 42nd St., N. Y. 18, N. Y.

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4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in said stock, bonds, or other securities than as so stated by him.

THOS. A. TRUMBOUR, General Manager.

Sworn to and subscribed before me this 28th day of September, 1951.

EDWARD A. STEVER
Notary Public, State of New York
No. 41-9191100
Qual. in Queens Co., Cert. filed in
N. Y. County Clerk & Register
(Seal) Term Expires March 30, 1952

The Bright Acid Bath—*Mr. William Innes.*

Tickets for the annual banquet, scheduled for Saturday evening, December 1, may be obtained from *Mr. O. H. Tiedeman*, 526 Catalpa Drive, Birmingham, Michigan. Orders for tickets, at $10.00 each, must be accompanied by remittance in full. Tables, if requested, will be assigned on orders in blocks of ten tickets.

New York Branch

The Sept. meeting of the New York Branch of the A.E.S. was called to order by *Mr. Herrmann*, the President, on Friday, September 28th, at the Hotel Statler, New York.

The minutes were read and approved. *Dr. Joseph Cuthbertson* and *Dr. Wallbank* from England were introduced to the members.

Mr. Reich, Mr. Roberts, Mr. Kuperschmidt, Mr. Abrams and *Mr. Cuthbertson* applied for membership in the New York Branch.

Mr. Carmine C. Dinallo was elected to membership and duly installed.

Mr. Milton Nadel read the minutes of a special meeting of the Executive Board of the New York Branch to the membership.

It was announced that *Mr. George Shore* is to be Chairman of the National Convention to be held in New York in 1954.

Following the business meeting, a general discussion on shop problems was read by the Librarian, *Mr. De Waltoff.* A large portion of this discussion centered around the nickel-tin alloy plating processes currently employed in Great Britain. Dr. Wallbank, who has operated such a bath, answered the many questions on these procedures by the membership.

Indianapolis Branch

The Indianapolis Branch held its monthly meeting Oct. 3 at Fox Steak House, with the usual steak dinner preceding the business meeting. Present for dinner were 32, and 43 for the business meeting. One member, *Mr. C. A. Barker*, again drove from Mt. Carmel, Ill., a distance of 165 miles.

Minutes of last meeting were read and approved. Secretary read a letter of appreciation for the excellent job done by the Buffalo convention committee.

Four were elected to membership: *W. Raymond, F. Anderson, John Marshall* and *Ted Wilhoite.*

There was much discussion in relation to next annual dinner dance.

The technical subject of the evening was "*Hard Chrome.*" The round table discussion was conducted by the following panel; *C. Gough, A. Kriese, Dr. Ammerman, W. Niehaus.* Many questions were answered and various phases of hard chrome were discussed. There was so much interest that it was hard to adjourn the meeting.

Philadelphia Branch

The Philadelphia Branch of the A.E.S. will hold its Annual Educational Session (1:30 p.m.) and Banquet (7:00 p.m.) on Saturday, November 17, 1951, at the Broadwood Hotel.

The speakers at the Educational Session are as follows:—

Dr. William Blum, National Bureau of Standards—"Summary of Electrodeposition Researches at the National Bureau of Standards."

C. F. Nixon, Ternstedt Division, General Motors Corporation — "Decorative Chrome Plating without Nickel."

G. S. Mustin, Bureau of Aeronautics,

Navy Department — "Corrosion Prevention by Plating and Surface Treatment in Naval Aircraft."

Boston Branch Annual Educational Session and Banquet

The Boston Branch of the A.E.S. announces that their annual banquet and educational meeting will be held on April 19th, 1952, at the Hotel Statler. Complete details of arrangements and speakers will be announced in a later issue.

Chicago Branch

On September 14th the Chicago Branch started their new season of Educational Sessions, and in order to bring out a maximum number of members, a panel on "Mechanical Plating" and "refreshments" were the lures.

Bill Geismann, of National Lock, *Dr. Harold Weisner*, of Bendix, and *Marion Longfield*, of Pheoll were the panel members. All the speakers were excellent, but particular praise is due the *National Lock Co.* for permitting Bill Geismann to present a vast amount of statistical data correlated into a quality control plan for barrel plating. This sort of management cooperation cannot be too highly commended. The meeting was further embellished by the short talk from new National Honorary Member, *H. A. Gilbertson*.

Cincinnati Branch

The 1951-52 season of The Cincinnati Branch of the A.E.S. got off to a flying start on September 26 when some twenty-five members and guests turned out for dinner. Another dozen members joined the diners for the regular meeting, which President *Robert Miller* opened in an auspicious manner by introducing *Walter Dietrich*, of *Plating* magazine. Mr. Dietrich gave a short talk in which he explained a great many details incident to the publishing of the A.E.S. monthly magazine.

The Secretary read correspondence which had accumulated over the summer including a letter from former President *Ezra A. Blount*, who is now serving with the Armed Forces in Tokyo.

Dr. R. C. Gibson, Director of Research and Technical Director, *Parker Rust Proof Co.*, Detroit, was then introduced by President Miller, and chose *"Phosphate Coatings"* as his subject. Dr. Gibson explained that such coatings are applied on metal by chemical reaction without the use of electricity. He stated that the coating time for paint purposes by means of a spray gun had been reduced to one minute, whereas an immersion bath would require five minutes, although a recent development required but one second to apply the proper coating.

The Doctor used slides extensively to show the comparison of metal treated with phosphate coating for (1) Paint Base, (2) Corrosion Resistance, (3) Wear Resistance and (4) as an Aid in Cold Forming.

The meeting was then adjourned for the usual Social Hour with The Parker Rust Proof Co. acting as hosts.

Pittsburgh Branch

The Pittsburgh Branch of the A.E.S. held its first meeting of the new year September 13, 1951 at the Sheraton Hotel with 24 members attending the dinner and 40 members present at the meeting itself.

Guests introduced by President *R.*

A. Woofter were: *Mr. Turk*, Beacon Co.; *N. Bulger*, Diversey Corp.; *D. Justad*, Minnesota Mining; and *A. K. Graham*, Executive Secretary of the A.E.S.

Two applications for membership were submitted. They were *N. Bulger* and *D. Justad*.

After the usual business proceedings *R. E. Varner* introduced the speaker for the evening, *Mr. Cleve Nixon*, National President of the A.E.S. Mr. Nixon's informal discussion of the Society's' aims and policies proved both informative and entertaining to all present.

Baltimore-Washington Branch

The first fall meeting was held at the Park Plaza Hotel in Baltimore on Tuesday, October 9th. Herb Struckhoff, President of Lasalco of St. Louis, journeyed in to give one of his pet topics, "What Happens in a Plating Barrel." In addition to his excellent presentation of this topic, Herb also displayed color films of mock-up barrels in operation which fortified all his theories.

Following the speaker a short business meeting passed a motion to present Dr. Blum with a practical gift at the November meeting, just prior to his retirement.

A twenty minute color film was then shown by Herb Struckhoff which showed Grand Canyon as few have seen it—clear, defined and without fog or mist.

The members then retreated to the rear of the room for refreshments and tête-a-têtes.

Los Angeles Branch

Appearing as principal speaker at the October 10th meeting, *Sid Solomon*, chemical engineer of the Los Angeles Water Softener Company, told members of the Los Angeles Branch of the American Electroplaters Society how plating room efficiency and production quality can benefit from proper treatment of water.

Mr. Solomon spoke on the main subject of "Ion Exchange in the Plating Room." However, under the urge of numerous questions from the floor, he strayed far afield from the programmed subject in an effort to oblige platers who were eager for information on water used in the plating shop and allied matters pertaining to softening and demineralization of the shop water supply.

As a graduate chemical engineer of the *Cooper Institute* of Technology, New York, and an engineer with the *Los Angeles Water Softener Company*, Mr. Solomon has had considerable experience in the installation of water demineralizers in plating rooms. He was able, therefore, to give the Los Angeles A.E.S. members and their guests a thorough picture of the benefits that may be obtained from such equipment, how practical it would be in different types and sizes of shops, and approximate cost figures for operation and installation.

He explained the theory of ion exchange declaring that the process can be broken down into three categories: Cation exchange, which, he said, requires a cation in the plating solution, and under which process an undesirable element or elements in the solution are exchanged for desired ones; sodium ion, which Mr. Solomon declared to have been in use for some four decades as the main factor in one of the better known water softening processes; and the third cation frequently used, he said, is the dehydro-

gen cation. He explained that for demineralization of water the hydroxal and dehydrogen cations are most widely employed. He cited caustic soda or soda ash as the regenerants used.

Mr. Solomon emphasized that in demineralizing water nothing is actually *removed* from the water, but undesirable elements are being replaced with desirable ones. He added that no actual exchange of elements takes place but that the phenomenon occurring is more in the form of absorption.

Impurities can be removed from plating baths, enabling the solution to be used again, the speaker declared, adding that the use of ion exchange in the plating shop is literally in its infancy with possibilities being unlimited.

President *Roy Lostutter* presided over the business session. The following guests were introduced by Sergeant-At-Arms *Frank Virgil*; *Oscar Stein*, Super Matrix Company; *Edward Cox*, S&M Lamp Company; *Don Smalley*, Auto Club of Southern California, Santa Barbara; and *Mr. Solomon*.

Walter Behlendorf, chairman of the board of managers, reported that an additional $1,500 of branch funds had been invested in Victory Bonds, making a total of $3,500 so invested. The bonds were given into the custody of treasurer *Peter V. Rogers*.

William Corrigan of Lumidor, Inc., and *Willard Baer* of Spence Electroplating Company were initiated into membership. *Ralph Alexander* of North American Aviation Corporation filed application, which will be acted upon at the November meeting.

In his capacity as membership chairman, First Vice-President *Myron H. Orbaugh* has prevailed upon Secretary *Stuart Krentel* to enclose an application blank in the mailing of each meeting notice. Orbaugh's goal is to have each member obtain one new member.

Incidentally, Krentel is doing a top-flight job in writing the meeting announcements. They differ from the usual announcement in that they provide the member with a fairly complete history of the forthcoming speaker, along with tid-bits of the subject to wet the appetite. That Krentel's system is working is shown by the fact that meeting attendance has substantially increased since he took over as secretary, and Orbaugh as membership chairman. The average attendance per meeting now is about 75 members and guests and no little of the credit due to Stuart Krentel's happily phrased announcements.

That *Jack F. Beall*, chairman of the research program committee, has devoted serious attention during the past summer to the task of obtaining supporting memberships for the Supreme Society research program, was indicated by the excellent erport he was able to give at the October meeting.

Mr. Beall reported that a total of ten Southern California firms had signed to contribute $100 annually to the support of the research fund. These are: *Crown City Plating Co.*, Pasadena; *Modern Plating Co.*, Inglewood; *Hallenscheid-McDonald Co.*; *Kelite Products, Inc.*; *A. J. Lynch Co.*; *George E. Nichols Co.*; *Price-Pfister Brass Co.*; *Turco Products Co.*; *Surface Alloys Co.*, and *U. S. Spring & Bumper Co.*

To round out an even more successful report for Jack, it was announced that Los Angeles A.E.S. Branch had voted to contribute $100 to the research fund as a sustaining member,

thus making the 11th from Southern California.

THE ELECTROCHEMICAL SOCIETY

New York Branch Hears Tin Plating Expert

At the September 26 meeting of the New York Branch of the *Electrochemical Society*, held at the Holley Hotel, *Dr. J. W. Cuthbertson*, Assistant Director of Research of the *Tin Research Institute*, London, England, discussed the deposition of tin alloys. His talk covered the progress made in this field in recent years, with special reference to processes which have become commercially important both here and abroad.

In discussing tin-zinc alloy plating, Dr. Cuthbertson reported that 25-30 production installations are now in operation in England and Europe. The bath deposits an alloy of 78% Tin—22% Zinc. Operating experience shows that the major production difficulty lies with the rapid carbonate build-up in the bath, necessitating a carbonate-crystallization treatment every 6 months or so.

Speculum plating (45% Tin—55% Copper) is being used commercially, especially where its extremely high reflectivity is important. It compares with silver in this respect, and resists tarnishing to a much greater degree. One of the practical difficulties with this process involves controlling the composition of the alloy deposit. As the ratio of tin to copper in the deposit varies widely with differences in current density, care must be taken in racking, etc. to insure uniform C.D. over the total area of the part. This problem has led to difficulties in adapting the process for job shop work, but well-engineered production systems are working successfully.

Recent work indicates that speculum can be used in place of nickel as an undercoat for chromium. In this case close control of the deposit composition is not so important, but the problem of dull chrome deposits over speculum has not as yet been fully solved.

The more recently developed process for depositing tin-nickel alloys shows excellent promise of becoming commercially important. Deposits of 65% Tin—35% Nickel show commercially acceptable brightness as deposited, hardness about 700 Vickers (stress free), good antifriction qualities, tarnish resistance as good as chromium, constant alloy composition on very irregularly shaped articles, and exceptionally high throwing power. The deposit has a pleasant pinkish tinge, and is extremely resistant to nitric acid attack. One commercial installation is now operating in England, with another in the process of setting up to plate a wide range of products. At present a dual-anode system is used, with the tin anodes being removed when the bath is idle to prevent immersion deposits on them. Considerable difficulty is encountered in making a suitable alloy anode for this process, but if this can be accomplished there would be no need for the dual-anode system, Dr. Cuthbertson stated.

A question period on tin alloy plating concluded this extremely interesting and informative meeting.

SHOP PROBLEMS

(*Continued from page 78*)

Hard Chrome on S.A.E. 4340 Steel

Question: We have had some difficulty in plating hard chrome over S.A.E. 4340 steel. In many cases we get no adhesion. We are using a 5 minute immersion etch in 20% sulfuric acid, followed by a two minute anodic alkaline cleaning. Our difficulty seems to lie in the etching step, and we would appreciate any suggestions for alleviating this difficulty.

T. W. D.

Answer: The following cycle has been used with good results in the shop of one of the most successful hard chrome platers in the country, and is recommended for this steel:

1) Reverse current clean in an alkaline steel cleaner, then etch anodically in a 28 oz./gal. chromic acid solution for 3-5 minutes.
2) Transfer the parts directly to the hard chrome tank and chrome plate directly.

Nickel Plating on Cast Iron

Question: Can you give me any information on the proper method for cleaning cast iron for nickel plating? We have the problem of putting a soft nickel plate directly on cast iron shears, and so far our efforts have resulted in a lot of peeling of the deposit.

P. A. P.

Answer: The following steps are suggested for preparing cast iron for plating with nickel:

1) Sand blast or roll in sand if necessary. Machined or ground surfaces do not require this treatment.
2) Vapor degrease if necessary to remove coating or grinding oils.
3) Soak in alkaline cleaner at 160° F. Any good alkaline cleaner compounded for steel would be satisfactory.
4) Rinse thoroughly.
5) Anodic electroetch in 25% sulfuric acid at about 200 amps./sq. ft. for about 5 minutes.
6) Rinse.
7) Nickel plate direct.

To obtain a soft nickel deposit, a low pH Watts bath is recommended, as follows:

Nickel sulfate	44 oz./gal.
Nickel Chloride	6 "
Boric acid	5 "
pH	1.5-3.5
Temp.	115-140°F.
C. D.	25-50 a.s.f.

Barrel Plating Speeds

Question: We are attempting to check our barrel plating performance against average commercial practice, and would appreciate it if you could supply figures on the time required to plate a given thickness of the various metals under ordinary shop conditions. We do not want theoretical figures, as we have found in our own operations that theoretical figures cannot be depended upon.

B. P. E.

Answer: Some published tables on this subject give the following performance figures for the average (14 x 30") barrel operating at 11-12 volts open line. The area of the parts being plated was approx. 60 sq. ft.

Metal	*Amps. Drawn*	*Time for .0001" deposit*
Cadmium	500	9 minutes
Copper (cyanide)	300	21 "
Brass	250	25 "
Nickel (warm Watts)	200	40 "
Silver	300	9 "
Tin (alkaline)	300	29 "
Zinc (cyanide)	600	10-11 "

These figures are fairly representative of commercial practice, but can vary widely under special conditions. However, they may be used as a guide in judging your own operations.

Electrocleaning in Baskets

Question: We always seem to have trouble in plating small parts that are cleaned in steel baskets. We run other racked parts through the same cycle and do not have any trouble in obtaining blister-free plating. Our cleaning operation was recently changed to electrocleaning to help clear up this trouble, but we still have the same results only on the basket work. Can you suggest anything that would help us in this problem?

T. F. N.

Answer: Electrocleaning does not usually work too well for cleaning small, tightly packed parts in steel (or other metal) baskets, due to the fact that the basket itself conducts practically all the current. Using an insulated basket for the electrocleaning operation would overcome this. Another suggestion would be to use a rotating barrel made of a non-metallic material, such as is used in the plating tank.

In soak cleaning in baskets, it is essential that the load of work be thoroughly shaken every few minutes to expose all the surface of the parts to the solution. Frequently overloading of the baskets prevents thorough cleaning.